What's COOL in STEEL 2005

by Lena Singer

Always on the lookout for intriguing news related to structural steel, *MSC*'s editorial staff has pulled together this **cool** collection of our favorites.

cool technology:

3D Printing

Imagine this: A CAD file of a structure is sent to a printer. Hours later, a complete 3D model comes out. Three-dimensional rapid prototyping machines—or 3D printers—are making this possible. The printers work by importing STL files to create 3D models layer by layer.

Since their introduction to the market in the 1990s, 3D printers have been used by industrial designers to create 3D prototypes relatively quickly and affordably. Increasingly, however, members of the architectural and structural engineering communities have been taking advantage of 3D printers' ability to produce structural models.

"That's one of our fastest-growing markets," said Tom Clay, President of Massachusetts-based 3D printing company Z-Corporation. According to Clay, the architectural community now accounts for 10% of the company's business.

"You can scale down any size of model," said John Cobb, Vice President of 3D Printing for Dimension 3D Printing Group, a division of Minnesota-based rapid prototyping company Stratasys. "If you want to look at the overall size and scope of a building, or at the specific feature details, you can."

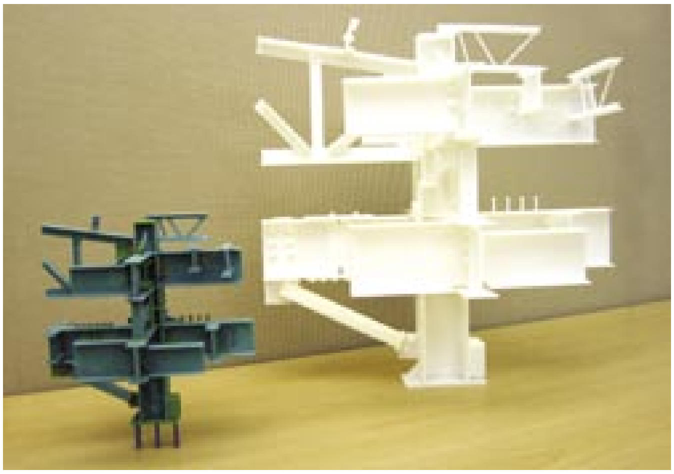
Dimension printers create models using the patented Fused Deposition Modeling (FDM) process. Models are built with layers of plastic heated to a semi-liquid state. Support structures are built into the model during the process and are removed once it is finished.

Z-Corporation uses a patented process that employs HP inkjet printing technology to build models with layers of powder and water-based binder. As each layer of powder is placed, the cross-section of the model is glued solid by an inkjet print head. The loose powder that surrounds the glued area provides support during the printing process. Once complete, the powder is vacuumed from the finished model.

Model build sizes vary for each company by machine, and sizes larger than the maximum build sizes can be made by either company by gluing separate parts together. Z-Corporation printers have a minimum build size of 8"×10"×8" high and a maximum build size of 20"×24"×16". Dimension printers have build sizes of 8"×8"×12" high, while Stratasys systems have a maximum build size of 23.6"×19.7"×23.6".

Z-Corporation models are created at a rate of one vertical inch per hour and with material costs between $1 to $2 per cubic inch. Printing speeds for Dimension systems depend on the geometry of each model—a 5"×5"×5" hand-held model typically takes three to four hours. Material costs are $4.40 per cubic inch.

For more information about Z-Corporation visit **www.zcorp.com**. For more information about Dimension 3D Printing Group or Stratasys visit **www.dimensionprinting.com**. •



To demonstrate the concept of 3D printing, models of AISC's Steel Connections Sculpture were made using an export from StruCad 3D modeling software (thanks to Ian Coats of StruCad), which produces shop drawings, erection plans, material lists, and CNC data automatically. See **www.strucad.com** for details. Z-Corp's model (left) is about 8" tall and uses color to denote different parts of the structure (for example, rolled shapes are green, bolts are purple, etc.). Dimension's model (right) is about 14" tall and uses one color throughout, although several different color choices are available.

cool company:

Cianbro Corporation

As healthcare costs continue to rise and many companies slash benefits, Cianbro Corporation, a major East Coast construction company, has gone against the trend and has steadily offered its employees more and better healthcare and wellness services. The employee-owned, AISC member company was honored in April 2005 by the American Heart Association with a Gold Heart Award. Cianbro was chosen for its leadership and innovation in employee wellness programs.

Beginning in the late 1990s, Cianbro has participated in the United States Public Health Service's Healthy LifeStyles Program. The company's human resources department, with local medical professionals, guide employees through the program, which provides education on wellness issues and encourages regular physical activity.

In 2001, the company added a $1,500 annual incentive to employees and their families for joining. One-on-one health education was established, and software for tracking individual health risk appraisals was brought in.

Today, in addition to the programs offered in the past, Cianbro pays for 80% of employee healthcare costs and 100% of preventative testing with zero deductibles. The company offers even more wellness education and is now a smoke-free work environment.

Cianbro says its increased investment in employee wellness has generated favorable results—despite rising healthcare costs, its costs have remained well below the national average, even with the added benefits.

Aside from the Gold Heart Award, Cianbro also has been recognized as "the healthiest company in America" by the American College of Occupational and Environmental Medicine and has received a "Gold Level of Achievement" from the Wellness Councils of America. •

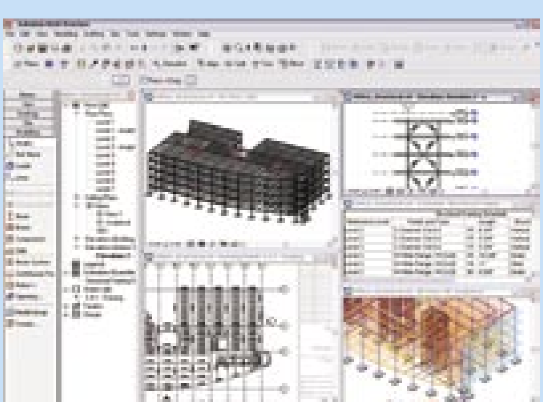
cool philanthropy:

"Invest in Education"

Autodesk, producer of AutoCAD, has been connecting its customers, as employers, to designers of the future through the Invest in Education program.

For each new seat of the most current versions of select Autodesk software and services purchased, the company has given customers the opportunity to donate an Autodesk classroom lab or collaboration services to the educational institution of their choice.

The list of eligible software and services include Autodesk Inventor Professional 10, Autodesk Inventor Series 10, Autodesk AutoCAD Electrical 2006, Autodesk Building Systems 2006, Autodesk AutoCAD Revit Series 8, Autodesk Revit Building 8, Autodesk Civil 3D 2006, Autodesk Map 3D 2006, and Autodesk MapGuide Server. The company will add their AutoCAD Revit Structure software to the program by the end of this year.

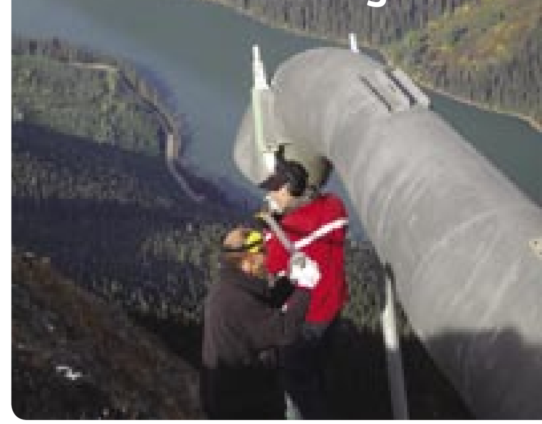


For every five seats, upgrades, or cross-grades of software packages purchased, 25 seats of the same software can be donated as a classroom lab. For every one-year service subscription purchased, a year subscription is donated.

The program, launched August 2004, is funded by Autodesk through a grant of more than $22,000. For information about how to participate in the Invest in Education program, contact invest-in-education@autodesk.com. •

cool career:

Extreme Welding



Everyone looks forward to a break in their daily routine. For machine shop owner John Tschopp, 59, of Pemberton, BC, that break comes once a year when he is flown to the top of a 7,600' mountain to perform maintenance welding on avalanche guns. The guns are used by the British Columbia Ministry of Transportation and Highways to create controlled avalanches that prevent real ones from pummeling mountain highways.

Tschopp has owned and operated Beaverlodge Machineshop in Pemberton for 27 years. Four years ago, he was recruited to perform this "extreme welding" by the Ministry.

"It's like mountaineering," said Tschopp, who wears a safety harness while welding cracks in the guns, which are located on vertical rock faces. "I hope the rope would hold me back if I were to fall, but let's say the rope broke—I would go down probably 1,000 m (3,281')."

Tschopp says the welding isn't special. "It's nothing exotic," he said, explaining that most of the work is standard stick welding using a 1/8" rod on galvanized steel. "The greatest challenge is getting there."

Tschopp, along with two Ministry workers, arrive by a helicopter that lifts his generator by a long line. The generator, he says, is a large part of why he was chosen for the job.

"They needed somebody with a welding machine that's light enough to be held by helicopter," he explained.

Tschopp uses a 256 lb Miller Electric Blue-Star engine-driven welding generator, which provides 4,500 watts of 120/240 V power and 145 amps of welding power.

They also needed someone willing to take the risk.

"I agreed to do the monkey work," Tschopp said. "I guess not everyone would want to do that." •

cool construction:

Hearst Tower

The new steel-framed Hearst Tower, under construction on New York City's West 57th Street, combines preservation, innovation, and conservation for the purpose of consolidating Hearst Corporation's 2,000-plus employees under one roof.

The 856,000 sq. ft, 46-story tower rests above the International Magazine Building, the communication conglomerate's original headquarters, constructed in 1928. The original building's limestone façade was restored and the space within will be renovated to serve as the new tower's lobby.

A steel "diagrid" framing system—with each of the grid's facets reaching 54' in height—will provide a 2,000-ton savings in steel compared to more traditional vertical systems. The diagrid, designed by structural engineers Cantor Seinuk Group, transfers building loads to the foundation with only 10,480 tons of steel. The 597' building features 13'-6" floor to floor heights, with each floor at 20,000 sq. ft.

Beyond its 100% recyclable steel frame, some of the tower's environmentally friendly features include carpets made from recycled materials, a humidification and cooling system that employs harvested rainwater, a slab-integrated heating and cooling system controlled at a floor-by-floor level, and low-toxicity paints and sealants. As a result, the corporation has asserted its plan to seek a "gold" Leadership in Energy and Environmental Design (LEED) rating from the U.S. Green Building Council.

The Hearst Tower's topping out celebration was held February 2005, and the project is scheduled for completion in June 2006. For a complete construction schedule and more information about the structure's history and future, visit **www.hearstcorp.com/tower**. •

cool deception:

Steel Art Trees

NatureMaker, located in Carlsbad, CA, brings the technical and natural worlds together in their custom fabricated Steel Art Trees. The company was founded in the 1980s by the late Bennett Abrams, an ecologist and sculptor, and Gary Hanick. Since then, NatureMaker has created indoor and outdoor "trees" for libraries, casinos, resorts, museums, nature centers, zoos, restaurants, and private homes around the world.

The trees can be designed as free-standing structures or as column cladding. Each one is the product of collaboration between engineers, certified welders, sculptors, scenic artists, and painters.

According to Hanick, the trees are viewed as "giant cantilevered structures," with the structural weight concentrated at the bottom.

"Without steel, we wouldn't have the support or materials to do this," Hanick said. "It gives us the ability to build really mammoth trees, in terms of height and trunk and canopy width."

The trees are carefully engineered—each one is designed to comply with local seismic, building, safety, and fire codes. NatureMaker designers also work with the structural design team early in the process to ensure that structural supports, such as floor reinforcements, and footings are provided within the building. By incorporating the trees into the building's design, they can be installed without additional supports.

The infrastructure of each tree is comprised of HSS steel, steel mesh, and rebar. Then, a substance simulating bark—a composite of fire retardant materials, resins, and epoxies—is applied. After hand-carving, hand-painting, "aging," and application of fire retardant leaves, the tree is ready to be shipped. The trunk and limbs are designed in sections with lock and key apparatuses for easy disassembly, shipping, and installation.

After 22 years, NatureMaker's portfolio includes redwoods, oaks, olive trees, African rainforests, and bamboo groves. Steel Art Trees have been designed to be as tall as 120' for column cladding and 80'-tall for free standing trees. Many of the trees are twice as wide as they are tall, with up to 60' cantilevers. Visit NatureMaker's web site at **www.naturemaker.com**. •

cool computing:

Virtual Reality Steel

When you're staring at a computer screen, it can be hard to picture how a structure will look during its real-life construction sequence. With virtual reality visualization of steel construction, designers and subcontractors can view construction sequences at full size and in 4D.

For the past two years, researchers at the National Institute for Standards and Technology (NIST) have been experimenting with their virtual reality (VR) facility in projecting 3D and

4D steel construction sequences. Other facilities in the United States, including Penn State and Stanford University, are using virtual reality projections to display construction schedules, as well.

At NIST, engineers use the CIS/2 standard data format to convert models from commercially available 3D design review software packages into the graphics format required for them to be projected onto screens.

"It provides a very compelling way to look at a structure," says Robert Lipman, research engineer for NIST. "Rather than seeing it on a small screen in front of you, you can immerse yourself in it."

Immersion in VR facilities allows project team members to address coordination and scheduling issues by looking at the "real" thing. Each of a structure's different systems, whether steel, mechanical, electrical, or HVAC, can be brought into a single model to show how they will interact when brought into the field.

The NIST facility can now display portions of life-sized structures with thousands of parts and as many bolts, according to Lipman. As hardware technology improves, even larger structures will be able to be projected. And as processing and graphics speeds become more advanced, sequence displays will be quicker. •

cool bridge:

Rolling Footbridge

There's a new bridge in London, and it's not falling down—it's rolling up.

Completed in 2004, the Rolling Bridge offers pedestrians passage over a canal in northwest London's Paddington Basin. Unrolled, the wood and steel-framed bridge spans 50' (12 m) and is 5' (1.5 m) wide.

The bridge's eight sections are formed by pairs of vertical pistons, each of which support handrails. The handrails lock into place when the bridge is lowered and form the top chords of its trusses.

The bridge is powered by a hydraulic system. When the bridge is signaled to open, cylinders push upward and extend in synch, causing the bridge to smoothly double backward. At first, the eight sections curl slowly but gain momentum as they draw closer together. After approximately two and a half minutes, the closed bridge forms a complete octagon on one bank of the canal.

The bridge was designed by London-based designer Thomas Heatherwick, known for public artwork as well as youthful urban design, product design, and civil engineering projects. SKM Anthony Hunts, of Cirencester, UK, provided the structural engineering. •

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Figures 1, 2, and 3 show the sequence of the bridge unrolling after being opened to allow passage through the canal.