On the Horizon

Compiled by Beth S. Pollak

As the new year begins, innovations in the structural steel industry are challenging architects, engineers, detailers and fabricators to change their perspectives. *Modern Steel Construction* took a look at what's new for 2003—and beyond—by asking some of the experts to share their thoughts.

David Eckmann is structural department head and principal at OWP/P Architects, Chicago, IL.

Don Engler is vice president of international operations for BDS Steel Detailers and Pacific Computing, Mesa, AZ.

Chris Fischer is production manager for Tekla Corporation, Phoenix, AZ.

David Henegar is president of Steel Detailing International, Inc., Rossville, GA.

Q: Do you see any trends in architectural and structural design involving structural steel?

Eckmann: One area that I can say is really impacting architectural design in steel is steel bending. We're seeing it with Frank Gehry's work. Beam-bending firms can take beams that are 100'-long and bend them into any shape that you want. A light structural form like structural steel gives great architectural freedom.

There was a time when you could not bend the shapes, when you had to make custom plate girders formed though a series of segments. With today's equipment and technology, now you can do it with a series of radii. You can create a single curve about its strong axis or about its weak axis. You can create reverse curves, different shapes, and helical forms with wide flanges, HSS or almost any steel member. As a result, you can use steel for applications where it wasn't previously cost effective.

Q: We've heard that steel castings are becoming more common in Europe for structural connections. Could you elaborate?

Eckmann: The use of steel castings can provide opportunities to create unique and attractive structural connections, where steel fabrications might otherwise appear bulky or be prohibitively expensive. One appropriate application for steel castings is where several structural elements come together at a common node, as at the Stuttgart Stadium in Stuttgart, Germany (see photos, opposite).

Steel castings can also be used when the steel structure is expressed in the architecture, and where the structural connections are articulated and celebrated in the architecture. An example of where this has been successfully incorporated is at Waterloo International Terminal in London, England. In that case, the structural design was based around the form of a three-hinged arch. The structural analysis of a three-hinged arch is typically modeled with three "pinned" joints that have the ability to rotate freely. The pinned joints usually are fabricated with plates and bolts, and do not allow true rotational freedom. The connections are also not particularly attractive.

At Waterloo International, steel was cast to create pinned connections that were designed to provide full rotational capabilities of the joint – literally, to perform as pins. At the same time, the castings were an attractive design solution that became a design feature of the architectural form.

Q: Are there any other new developments in Europe?

New Technology: Steel Castings

Castings are ideal for situations where several members converge, and would otherwise create a complicated and expensive fabricated connection. Column transition detail is at Stuttgart Stadium, Stuttgart, Germany

A steel casting creates a literal "hinge" connection of a three-hinged steel arch at Waterloo International Train Terminal, London, England.

A steel casting for the cable net observation tower at the summit of Killesberg Park represents a three-dimensional "rocker" base detail. Stuttgart, Germany.

Eckmann: The use of cables in architecture with steel also stood out. There are manufacturers making full-lock cables. These cables are made up of hundreds of wires that have an outer perimeter shaped like the letter "z," so they interlock and eliminate water infiltration. The life of the full-lock cable could be unlimited. Design with cables has not been well received in the past, because of the potential deterioration of the cable. Full-lock cables make working with cable a more viable possibility for design solutions. OWP/P is currently designing the Rattner Athletic Center at the University of Chicago with full-lock cables from Germany. This will be the first time they'll be used in the United States.

Q: What about engineering and detailing software?

Henegar: The biggest change I see is the use of electronic data interchange (EDI), not only from engineers to detailers, but from detailers back to engineers. Detailers can use programs to produce information and manage data that they can then send back to engineers and other team members.

Engler: From a software standpoint, there is now a recognition that creating a single, 3-D model provides benefits and value to a project team. Instead of a time-consuming sequential design and detailing process, all the trades can work concurrently to generate the model. You can also use the model's database to generate a huge amount of information. Time is money on these projects. When a team works together, revisions can be incorporated easily. From a project management standpoint, it's much better. Most commercial projects in the United States are still following the old and cumbersome sequential process.

Q: What can we do to implement change?

Henegar: Change will result from three steps. The first is to get team members to change their basic work model. Designers and detailers are used to working in a 2-D environment, with electronic models supplementing paper documents. What's on paper is what governs and is what is more up-to-date. The future shift will be to the 3-D environments, with paper documents supplementing a governing 3-D model. There's a lot of skepticism, but all players need to get on board.

The second step is to create a system to protect and verify data-entry information. One reason why engineers and detailers are hesitant to use 3-D modeling is that they view their designs as proprietary. Engineers and detailers do not want anyone to copy their designs using the same models or drawings. At the same time, different team members do not want to be held liable for mistakes made to the 3-D model by other team members. It would be very hard to verify who's fault the mistake was. AISC is working with an EDI business model task force to develop a way to track changes made to the 3-D model, and to protect the design using encryption programs.

The third step is learning to play together and to end adversarial relationships—through design-build.

Engler: Design-build is the key to change. The team works together to reduce cost and to benefit the project. A traditional contractual relationship encourages everybody to be a low-bidder, so no one evaluates the lowest-total-cost concept—and that has stood in the way of model-based detailing. Design-build will be the vehicle to move things forward.

Fischer: New software actually enables the design-build process. The CIS/2 modeling format that translates between design and detailing software facilitates the communication that makes design-build possible. The problem comes because many fabricators don't have a personal computer, or even Internet access. They aren't going to see the benefits of a 3-D model, because for them, it doesn't make the steel flow any faster.

Q: What about using the Internet to collaborate on projects?

Engler: 3-D models can be posted on the Internet, so you can go to a web page and see the status of a project. International teams from various countries can handle single projects. A project located in Chicago might be designed in Europe, while the steel is fabricated back in the United States. Using the Internet is one way to prevent the delay associated with traditional data transfer.

Henegar: The creation of engineering-review workstations will allow engineers to review 3-D models that detailers use from a distant location. This can be done in a web-based or VRML-virtual reality viewer. A detailer's CAD system could export a VRML model that can be viewed by any team member. You can have six people dial into an Internet meeting and examine a model to see what problems you might have, and brainstorm potential solutions. A picture is worth a thousand words when you need to describe a design or framing problem.

Q: What do you see for 3-D modeling in the future?

Engler: I think that construction crews will also start to integrate their field data with the 3-D model.

Q: What are some of the newest software programs?

Engler: Tekla is launching X-steel products that design precast concrete in an engineering module, so that other trades can fall within the one model. This way, you don't need a translator program to transfer information between different trades.

Q: How is new software impacting fabricators?

Fischer: I've seen more effort as far as CNC equipment. Software improvements for CNC equipment can help solve nationwide manpower issues. Fewer skilled workers are entering the field. Good CNC software and equipment means more material that can be programmed automatically—which can bolster accuracy and productivity. Every step that detailing software producers take to improve the information provided reduces the time between project design and the fabrication of steel.

Q: What are some innovative machines that have been released?

Fischer: We have a machine that can bevel a plate with plasma. It is a few years old, but so far only has made inroads with shipbuilders. In one single operation, you can cut, profile, and bevel a plate in preparation for welding, without additional material handling. It's cost effective, and opens up new possibilities for curved designs in steel.

Q: Do you have any thoughts on how bar code technology will impact the industry?

Fischer: Bar codes will help fabricators with inventory control. We'll be able to make our inventory information more accurate. Right now, when a truckload of steel arrives at a fabrication plant, we can't always identify the material. Sometimes it's human error, or a time factor, but sometimes it's just a matter of legible handwriting. Bar codes will help us identify items all the way through the fabrication process. We can get an accurate receipt from mills. We can scan items with a bar code scanner instead of writing it on paper. AISC's committee on bar coding hopes to produce a standard for the whole industry.

Q: With all these innovations in mind—are things going to change anytime soon?

Henegar: People say that things won't change, because "we always used to have it this way." Well, we always used to have quill pens and candles, but now we have computers and electricity. The barriers will be broken eventually—things will evolve. ★