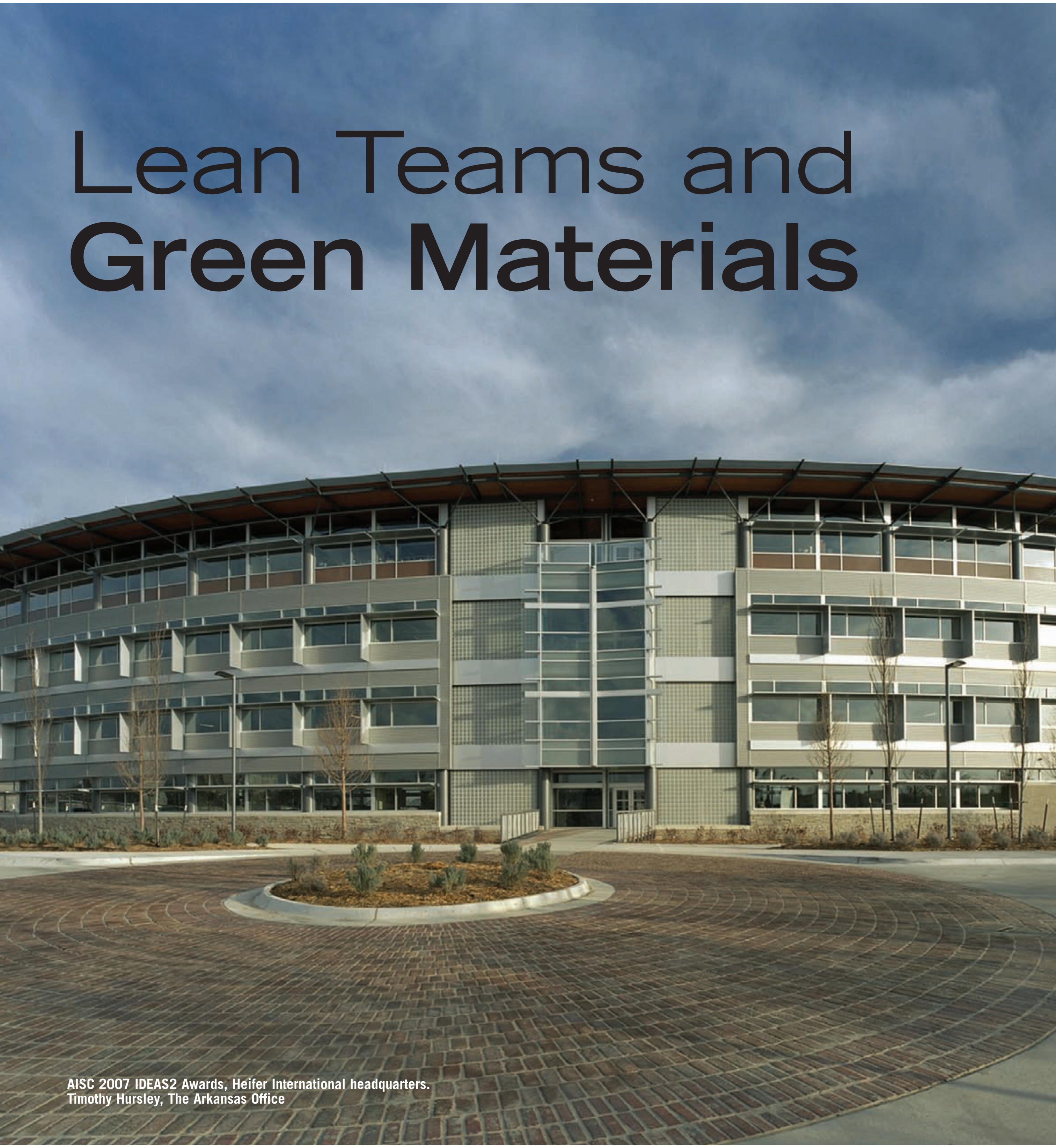
STEEL II

Lean Teams and **Green Materials**



AISC 2007 IDEAS2 Awards, Heifer International headquarters.
Timothy Hursley, The Arkansas Office

STEEL II

The Integration of a Structural Steel Team

Commitment and trust form the foundation for a steel team seeking to overcome industry fragmentation and bring greater value to clients in the delivery of the steel package

by Larry Flynn

A recent email from Larry Vaughn, superintendent for Shaw Construction, the primary contractor on the Rocky Vista University medical research facility in Parker, CO, sums up the work on the 147,000-sq-ft design-build project's nearly complete structural steel framing system—and pays perhaps the ultimate compliment to the structural steel team in the process. Extending a "huge 'thank you'" to Wade Lewis, project manager for the AISC-certified member structural steel fabricator Puma Steel, Cheyenne, WY, and Peter Radice, project manager for AISC-certified member erector L.P.R. Construction, Loveland, CO, Vaughn said that never in his 33 years in construction had things gone so well with the structural steel on a project.

Upon first meeting the seasoned construction veteran Vaughn, Nick Miller, L.P.R.'s regional sales manager, says he thought the team might have a rough time of it on the project. And before Vaughn came to know the members of the integrated design-build structural steel team known as Team Puma, he might have said the same thing about them. But the team's enhanced level of coordination and communication from design through erection translated into an efficient and cost-saving delivery of the steel package. Team Puma shaved four months off the construction team's schedule compared to the traditional design-bid-build delivery of the structural steel. This was also accomplished with steel mill rolling cycles on the long end of the supply cycle.

Team Puma's specialty structural engineer Martin/Martin Inc., Lakewood, CO, designed the structural system with ease of fabrication and erection in mind. "You knew how easy it was going to be to fabricate and erect," Miller says.

Working from a set of standards developed specifically for the team by the Team Puma members—AISC-member structural engineer Martin/Martin, detailer and fabricator Puma Steel, erector L.P.R. Construction and AISC-member steel producer Nucor-Yamato Steel, Blytheville, AR—Martin/Martin designed the structure so that Puma Steel wasn't required to cope the beams during fabrication. This saved fabrication time and allowed L.P.R. to erect the structure quicker by bringing the beams in straight on instead of at an angle, which would have been required had the beams been coped. L.P.R. simply "dropped the beams straight down and made up the connections," says Miller.

FORGING THE TEAM

Rocky Vista University is one of the latest of 25 projects that Team Puma has performed since the team established itself as a design-build structural steel entity in 2002. The team is representative of a significant number of successful steel teams across the country that have formed in recent years to deliver steel packages faster and more efficiently and economically.

Like most of its fellow steel teams, the members of Team Puma had worked with each other on projects for years and came together as a way to overcome the fragmentation that is commonplace in the building construction industry. Today's rigid segmentation of the disciplines in the typical

A plaza view of Rocky Vista University's 147,000-sq ft medical research facility building in under construction in Parker, CO.

RENDERING: TEAM PUMA

STEEL II

design-bid-build project delivery process tends to thwart collaboration and innovation and create an atmosphere of distrust and fear of litigation that stagnates productivity.

The building construction industry "is in a phase now where projects are coming out earlier than they used to and drawings aren't complete," says Miller. "There is a lot more room for error in pricing." The typical design-bid-build process now produces an avalanche of requests for information (RFIs) and change orders that slow down the schedule. This while project team members model their work in 3-D and then produce two-dimensional drawings to hand off to the next team member, which replicates the process because no system has been put in place to harness the power of interoperability and Building Information Modeling. And each member of the project team focuses only on its level of responsibility instead of the project as a whole, which leads to finger pointing and litigation. But according to Eric Moe, P.E., Puma Steel's director of business development, Team Puma's focus is on a common goal: how to provide better value to its clients.

According to Jack Petersen, P.E., a principal with Martin/Martin, because every typical design-bid-build construction project varies to some degree—the fabricator is hired by the general contractor, the structural engineer is hired by the architect, the players are usually different, the routing system is different—a new way has to be invented to complete the project each time. Team Puma's "process is down and we can focus our energies on the project," says Petersen.

In its quest to deliver greater value, the team developed a total delivery system that allows it to deliver a technical proposal for a project along with a firm price as early as the schematic design phase. "At best this is done off a schematic design drawing or even a sketch," Petersen says. Then, as the team's specialty structural engineer, Martin/Martin works hand-in-hand with the project's design team—in the case of the Rocky Vista project, architect OZ Architecture, Boulder, CO, and AISC-member engineer of record JVA Inc., Boulder, CO—to develop solutions that keep costs within the budget.

Typically, because schematic designs lack details, fabricators and erectors are forced to build contingencies into their prices, which can price them out of the job. The development of Team Puma's set of standards, or book of details, strengthened the team's relationships even further and provided a method from which the structural engineer could draw on the abilities, preferences and equipment capabilities of the fabricator and erector and figure them accurately into the design of the structure. "The most important part of the whole process is knowing what the details are," says L.P.R.'s Nick Miller, who admits he was pleasantly surprised on Team Puma's first project when the price held fast. "We now have the confidence that we have it right."

On most construction projects today, where the fabricator and erector don't come into a project until much farther downstream, their particular abilities and preferences are never able to be taken into consideration unless the project is over budget and the so-called value engineering process kicks in. To an even greater extent, the true value engineering in design, construction and cost saving that the fabricator and erector expertise can bring to a project in the early design phases is lost. Team Puma's system gives Martin/Martin "the opportunity for the builders to tell us how they want to build the project and then we engineer it—one time," says Petersen.

LIGHTER ISN'T ALWAYS BETTER

The team's design process works in reverse, with the erector typically driving the details of the structural design, says Puma Steel's Eric Moe. With the emphasis on ease of erection and reducing labor in the field, Team Puma's designs tend to involve heavier pieces with fewer connections that are bolted instead of welded and that can be produced on Puma Steel's automated CNC fabrication equipment. This contradicts the widely held notion in construction that lighter-weight structural steel systems are more economical.

The reality of a project is that labor is much more expensive than material. The labor in fabrication and erection amounts to approximately 70% of the steel package while the cost of the material accounts for about 30% of the total package. Lighter-weight systems typically involve more complex connections, which results in increased fabrication effort, more labor in the field and increased cost. Reducing the labor required in erection and fabrication benefits the

The steel frame under construction at Rocky Vista University. The project is scheduled for completion in August 2008.

PHOTO: SHAW CONSTRUCTION

STEEL II

design-builder and owner in the reduced cost of the project. It also benefits members of Team Puma, which can allocate their labor and equipment toward other projects.

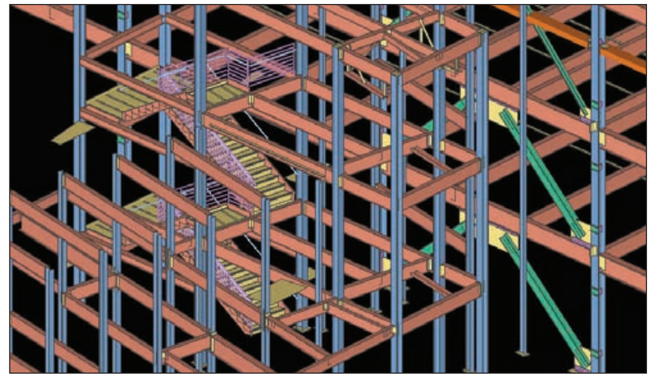
The U.S. Army's new Brigade and Battalion Headquarters in Fort Carson, CO, on which erection is nearly completed, is a classic example of Puma Steel's design philosophy. The contract for the design of the 140,000-sq-ft project, led by the design-build team of contractor Hensel Phelps, Greeley, CO, and architect RNL Design, Denver, contained force protection requirements for blast-resistant design and progressive collapse. "Going into the project it wasn't clear what we were going to have to do to make the force protection work and not blow our budget," says Martin/Martin's Jack Petersen. "Often times the details for progressive collapse are quite complicated. But working with the team, we were able to make a pretty straightforward design work and meet all the force protection requirements."

Instead of opting for a more standard approach of designing a system of individual light-weight kickers to protect the building's metal stud framing and ribbon window configuration, Team Puma devised a steel girt that spanned from column to column. This follows a general rule of thumb of steel erectors that fewer pieces are better than more pieces. "Each piece of steel probably weighed 10 times what the kickers would have weighed," says Petersen. "But it was one piece—and—it could be made on an automated beam line and was less expensive to fabricate."

The system works well for Team Puma, which specifically targets design-build projects with negotiated contracts. The team does not pursue projects that already have been designed, says Moe. Being a design-build subcontractor on a design-build project affords the team greater control over the steel package throughout the project. The team is sometimes approached to redesign portions of a design-bid-build project, such as a current proposal for the team to redesign the roof of a casino project. The complexity of the connection designs for the roof were deemed too costly and time consuming to fabricate, says Puma Steel's Eric Moe.

COMMUNICATION POWERS INTEROPERABILITY

The ability of Team Puma to deliver the steel package faster and more efficiently is significantly enhanced by the interoperability of the analysis and Building Information Modeling (BIM) software used by each team member, which enables the digital transfer of data between members. The software employed by each member of the team is compliant with the CIS/2 neutral file format platform that enables the structural analysis (RAM) and design software (Revit) to interchange information with the detailing software (SDS/2), automated CNC fabrication equipment and the software used by the erector (Xsteel and SDS/2) to plan the construction process. But while the technology employed is a tremendous asset to Team Puma's process, Petersen says that it is "the relationships and the trust that we have that allows us to take advantage of interoperability."



RENDERING: TEAM PUMA

A structural steel girt system, shown in orange in the top right of the rendering, enabled Team Puma to meet the force protection requirements of the Fort Carson project and expedite fabrication and erection.

Aside from its work with Team Puma, Martin/Martin generates many of its projects using RAM structural analysis software or in a full Revit 3-D model and soon will be designing all of its projects that way, Petersen says. "But on the majority of those projects, their power is not taken advantage of because the personal and contractual relationships don't exist."

In Petersen's experience, forethought on projects isn't often given to what that BIM model is going to become, except on Team Puma projects. With Team Puma, Martin/Martin "knows that we're building that model and were focused on dimensional precision," says Petersen. "In a BIM job where we're translating information to the fabricator, 2 inches means the whole world. We have to have it to the 16th."

Martin/Martin's commitment to keeping the model updated is the key to the team's successful use of interoperability and BIM, says L.P.R.'s Nick Miller. "It's lightening fast," he adds. L.P.R. uses the Xsteel and SDS/2 software to plan temporary bracing to stabilize the structure during erection. The software also helps the erector define where and how to attach picking points and configure rigging.

Puma Steel's Eric Moe says the team encourages the primary design-build contractor to use BIM more broadly on its projects and on a couple of occasions the team has been contracted to provide the model for use by the mechanical contractor. A California project may soon become another of the team's projects to have mechanical and shop drawings created off of the structural steel model.

While Team Puma is experiencing success using BIM on a micro level to deliver the steel package, Petersen acknowledges that implementing BIM on a horizontal basis across the entire building team is much more complicated. "It's coming," he says, "but for BIM to reach its full value we have to reach that same consensus among all levels and subs that we have with Team Puma—and that's a lot of people and a lot of trust." ■

STEEL II

Steel Roof and Wall Systems Provide Plenty of "Green" Options

by Toy Henson

Metal roofs and walls made of steel come in a variety of colors, but it's their "green" makeup that is prompting many building owners and architects to sit up and take notice.

For building owners and architects committed to preserving natural resources, metal roof and wall panels offer a unique, environmentally responsible and sustainable solution to their building's exterior requirements.

That's because roof and wall systems made of light gauge steel can contribute considerably to the green building movement due to their high recycled content, recyclability, sustainability and energy efficiency.

The recycled content of the steel used in metal roofs and walls, for example, is at least 25%. This level of recycled content reduces both the cost and environmental impact of making new steel, as it conserves energy and other natural raw materials.

The fact that the recycled content of steel is at least 25% also helps earn points in the U.S. Green Building Council's Leadership in Environmental and Energy Design (LEED) program.

RECYCLABLE

In addition to their recycled content, steel roof and wall panels offer the added benefit of being recyclable at the end of their "useful" life. For example, while many other roofing materials are dumped by the ton in landfills, the steel used in metal roof panels is 100% recyclable, contributing to future products' recycled content.

Moreover, in many retrofit applications, metal roofs can be installed over old built-up and single ply roofs. This eliminates the need to remove the old roofing material, and helps preserve valuable landfill space. In retrofit projects of this type, a sub-framing system is attached to the existing roof surface to provide a minimum $^{1}/_{4}$:12 pitch for the new metal roof.

And, as in the case of recycled content, steel has an advantage over many other construction materials since the metal can be re-used, while roofing materials such as asphalt or rubber membranes usually end up in a landfill. Wall materials such as precast concrete, stucco and EIFS often find their way to landfills as well.

MOST RECYCLED

Of the metals used in roofs and walls, steel is the most recycled. The annual recycling rate currently exceeds 70%, and its recovery rate is even higher, near 90%. Easily separated from other materials via magnetics, steel is reclaimed through a vast collection and processing network.

The steel in metal roof panels is 100% recyclable at the end of its service life.

New steel made with recycled material uses as little as 26% of the amount of energy that would be required to make steel from iron and other materials extracted from nature. The original embodied energy of steel products is amortized as steel is recycled again and again into new steel products.

EXTREMELY DURABLE

For years, building owners and architects recognized metal roofs and walls for their strength and functionality. Today, they are also recognizing another of steel's attributes…a long, sustainable service life.

Roof and wall systems made of steel are extremely durable, thereby lowering the demand

STEEL II

for raw materials needed to produce replacement systems. Significantly contributing to the service life of these roof and wall panels is today's generation of metal paint and coating systems. Modern technology has introduced quality finishes that not only protect and beautify the panels but are also warranted for decades.

COOL METAL ROOFS

In addition to their other environmentally friendly attributes, metal roofs and walls can also help reduce energy consumption. Metal roofs, for example, can be finished with heat-reflecting paints and coatings to lower energy usage by reducing cooling loads inside a building. These "cool metal roofs" can also reduce the "Urban Heat Island Effect" by lowering ambient outdoor temperatures.

Today's cool metal roofs can reflect up to 70% of the sun's rays, resulting in less heat transfer to the interior of the building and saving owners in energy costs. Moreover, an Oak Ridge National Lab study shows that painted steel roofs maintain 95% of their reflectance over time. This is important because many building codes assume reflective performance of all roof materials degrades at the same time.

One of the reasons steel roofs retain their reflectivity is because they shed dirt more readily than other roofing materials. And, the dirtier the roof, the more its reflectance is compromised.

LOW LIFE CYCLE COST

The durability of metal roofs also has an effect on their life cycle costs. In fact, metal roofs were found to have a significantly longer expected service life than either built-up roofing or single-ply roofs according to a study of low slope roofing conducted by Ducker Worldwide, a Detroit-based research organization that specializes in the construction industry.

Study participants said they expect steel roof systems to last 40 years—17 years longer than built-up and 20 years longer than single-ply systems.

Respondents also said they expected the life-cycle cost of a steel roof, including outlays for maintenance, to be about 30¢ a sq ft per year, significantly less the 37¢ for built-up roofs and 57¢ for single-ply roofs.

The expected low life cycle cost of a steel roof can be attributed, at least in part, to the fact that the owners and managers surveyed reported having to perform little or no regular maintenance to their metal roofs.

For more information on metal roof and wall systems for commercial buildings, visit *www.themetalinitiative.com*. ■

The steel used in metal wall panels contains a recycled content of at least 25%.