Interoperability and the Construction Process

A WHITE PAPER FOR BUILDING OWNERS AND PROJECT DECISION-MAKERS

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Executive Summary

The goal of this paper is to raise awareness among building owners/operators and project decision-makers as to the advantages of interoperability in the construction industry and to highlight its successful use by the structural steel construction sector.

According to the National Institute of Standards and Technology (NIST), interoperability relates to both the exchange and management of electronic information, where individuals and systems are able to identify and access information seamlessly, as well as comprehend and integrate information across multiple software systems. In the construction industry, inadequate interoperability prevents digital communications between software programs used by designers, contractors, specialty contractors, as well as building owners/operators.

NIST recently released a study quantifying the cost of inefficient interoperability in commercial, institutional and industrial facilities for the year 2002. Focused on both new and "set in place" construction, results showed inefficient interoperability increased new construction costs by $6.18 per sq ft as well as operations and maintenance (O&M) costs by $0.23 per sq ft. In total, inefficient interoperability cost the construction industry, as well as owners/operators more than $15.8 billion in 2002. Two-thirds of this cost was directly borne by owners/operators.

In an effort to eliminate information and labor redundancy, the structural steel industry has fostered a standard for interoperability of its design and construction software. The CIMSteel Integration Standards, Version 2 (CIS/2), enables designers and specialty steel contractors to exchange electronic data seamlessly, resulting successfully in both reduced project costs and schedules related to the structural steel frame. This is merely the tip of the iceberg in successful implementation of interoperability. To take full advantage of the opportunity to reclaim the $15.8 billion in waste, owners/operators must mandate the continued development and use of interoperable technology, across all stages of their projects, by all designers, contractors, specialty contractors and suppliers.

Recent Trends in Facility Construction

The structural steel industry has been a leader in improving the interoperability of software utilized by the structural steel design and fabrication communities. CIMSteel Integration Standards/Version 2 (CIS/2) is used to achieve interoperability between structural engineering, detailing and fabrication software systems. The development of CIS/2 has bridged the use of previously incompatible systems by translating a program's native format into a neutral file format that allows data interchange across multiple software programs. This enables the structural engineer, detailer, and steel fabricator to reduce the time required to convert designs to fabricate components, improve quality control standards, and reduce costs. Schedules are reduced by the ability to review and approve shop drawings as they are being developed; thereby, eliminating both the lengthy "revise and resubmit process" as well as the reduction of paper generation. In addition, drawings are more complete and the engineer can be assured that his design will be properly executed at the fabrication level.

The Lansing Community College Health & Human Services Career and Administration Building project is a prime example of how CIS/2 interoperability can be used to maximize efficiencies in the structural steel design and fabrication processes. Implementation of interoperability on only the structural framing phase of the project generated enough savings to help the owner decide in favor of accelerating expansion plans and adding the 4th floor. Along with being able to add the additional floor, the client was still able to lower the cost of the steel package by $315,000 ($2.35 per sq ft).

Even with late design changes during the bid process, the quick electronic transfer of structural data and cooperation of all stakeholders allowed the building team enough time to refine the scope of the project to meet project objectives set forth by the Lansing Community College administration.

"Douglas Steel submitted a low bid based on the original architectural designs and then supplied an alternative for our consideration," said Allen Blower, construction manager for Lansing, Michigan-based Clark Construction, the company that managed the project. "Douglas worked closely with Ruby & Associates, a consulting structural engineering firm, to come up with an alternative design that included an additional floor using 190 tons less steel then the original design. We accepted the cost savings and within two weeks, we approved final drawings. As a rough count, we eliminated more than 700 steel members, over 11,000 shear studs as well as all welded moment connections from the structure. We ended up with a thicker metal deck/concrete slab system that added a little dead load to the structure, but increased the strength of the composite beams. Basically, we made it easier to build, stronger, and much more economical. Plus, we stayed on schedule because the new design took only four days thanks to CIS/2 interoperability. The only way for this to happen was with the electronic transfer of data between Douglas Steel, Ruby, the architect, and me. The redesign couldn't have gone smoother—and the teamwork really was phenomenal."

In the days before interoperability, a proposal with a similar alternative would have come with a request for an extension of the project schedule because of the time it would take for the redesign, manual re-entry of data for the detailing process, and production of detail drawings. But today, particularly with structural steel, interoperability allows instant and accurate data transfer to implement these changes from design software through manufacturing equipment. Interoperability now facilitates the accommodation of last-minute structural changes without disturbing time lines. This ability is unprecedented in the construction industry and gives owners an opportunity to reduce costs while ensuring project objectives are met.

"As a construction manager, maintaining a tight schedule is everything, especially for school projects because you have to turn the building over so they can prepare for the beginning of the academic year," Blower said. "Interoperability let us consider options for Lansing Community College that we never would have had time to consider before."

According to Blower, the key to taking advantage of the time and money savings offered by interoperability is teamwork. "The owner must set the stage by involving all stakeholders early in the process and establishing project goals," he said. "But it really depends upon the subcontractors and how well they work as part of the team to make it happen. Cooperation between the fabricator, structural engineer and the detailer is essential for quick shop drawing development and approvals."

A Historical Perspective

The manufacturing sector has been a technological leader in the development of interoperability standards to manage and communicate electronic data between collaborating firms. As a result, manufacturers have increased efficiencies through the seamless exchange of information between dissimilar computer and software systems that enable the identification, access and integration of digital files instantly and accurately. The benefit of this application-to-application transfer of documents between multiple platforms is real-time tracking of business performance, orders, minimization of duplicate business functions as well as open communication.

Financial centers and medical facilities have also created interoperability standards to facilitate the exchange of data over the Internet, as well as intranets and extranets, to streamline processes and provide better services. In the finance sector, integration and standardization of data from various economic modeling systems provides information that is used to help decision-makers to maintain stability in the global economy. Progress in interoperability is extended to the healthcare industry, as medical records can now be sent digitally across the globe for instant, specialized diagnostic capabilities, improving healthcare and patient outcomes.

Costs of Inadequate Interoperability by Stakeholder Groups, by LIfe-Cycle Phase (in $Millions)

Stakeholder Group	*Planning, Engineering, Design Phase*	*Construction Phase*	*O&M Phase*	*Total*
Architects and Engineers	$1,007.2	$147.0	$15.7	$1,169.8
General Contractors	485.9	1,265.3	50.4	1,801.6
Specialty Contractors/Suppliers	442.4	1,762.2	---	2,204.6
Owners and Operators	722.8	898.0	9,027.2	10.648.0
All Stakeholders (Total)	2,658.3	4,072.4	9,093.3	15,824.0

Source: Table 6.1 NIST
Note: Includes commercial, institutional, and industrial buildings totaling 1.1 billion sq. ft. in "new" and 39 billion sq. ft. in "set in place" construction.

While many of these information advancements often go unnoticed or are deemed inevitable results of technological advances, achieving interoperability requires much more than simply automating a business process. An interoperability movement in any industry requires a concerted effort by industry stakeholders to change the status quo. Bluntly, there must be a considerable benefit for these stakeholders to change their practices to comply with new standards.

The Challenge in the Construction Sector

The construction industry has lagged behind other industries in accepting the benefits of interoperability. In the 1990s, while interoperability productivity benefits were being realized in other industries the building construction industry went largely unaffected. In fact, it was during the 1990s that construction was the only segment of the U.S. economy to experience a decline in productivity. Much of this was due to the fragmented nature of the industry where relationships between designers, contractors and subcontractors often inhibited communications and teamwork. The problem was compounded further by the fact that many design and construction firms were small and did not have the resources required to take full advantage of new information transfer technologies.

Another obstacle to industry integration efforts was a lack of return on investment data related to interoperable information technology. Prior to 2004, the construction industry lacked quantifiable information regarding the financial implications of inadequate interoperability. The NIST study, entitled "Cost Analysis of Inadequate Interoperability in the U.S. Capital Facilities Industry," analyzed current business practices against a simulated scenario where interoperability was fully utilized. NIST examined design, construction as well as O&M costs in large commercial, institutional and industrial buildings for the year 2002. The report conveyed that the construction industry has had to incur significant expense due to three types of interoperability costs: avoidance, mitigation, and delay. Avoidance costs include redundant computer systems, inefficient business process management and redundant IT support staffing. Mitigation costs include manual reentry of data and Request for Information management. Delay costs include labor for idled employees. The total figure of these costs, calculated based on industry stakeholder interviews and survey responses, is more than $15.8 billion in 2002. About 68% of this cost, more than $10.6 billion, is borne by owners/operators. The $15.8 billion loss reflects costs incurred during both construction ($6.8 billion) and operations and maintenance ($9 billion).

The report identified 1.1 billion square feet of floor space in new construction, and 39 billion square feet in existing facilities in 2002. Therefore, for the 1.1 billion square feet in new construction, which correlates to the planning, engineering, design, and construction phases of a facility's lifecycle, the cost is a very significant $6.18 per sq ft. This expense is shared among stakeholder groups: architects and engineers, general contractors, specialty fabricators, suppliers as well as owners and operators. The cost of a lack of interoperability for the O&M of the existing 39 billion square feet, is $0.23 per sq ft

Eighty-five percent of the O&M costs are borne by owners/operators, approximately $9 billion annually. This is primarily due to a failure to manage activities upstream in the design and construction process. Poor management and maintenance of as-built data, communication failures, inadequate standardization, and inadequate oversight during each lifecycle phase culminate in downstream costs. In addition to the quantified costs cited in the study, industry stakeholders indicated that there are additional costs for inefficiencies, such as lost business opportunities that were not calculated into the final figures due to the speculative nature.

The NIST report calculates the cost of inadequate interoperability by comparing current business activities and costs with hypothetical, yet comparable scenarios where information systems, management, and access are fluid and seamless. That means information need only be entered into a computer system once for all stakeholders to use through completion of the project. The difference between the current and hypothetical scenarios represents the total economic loss associated with inadequate interoperability.

For the purpose of the NIST study, capital facilities industry encompasses the design, construction, and maintenance of large commercial, institutional, and industrial buildings.

Fostering CIS/2 Interoperability

Just as the music industry agreed upon compact disks as the "standard medium" for the sale of music, leaders of design and construction related industries must cooperate to establish "best practices" that will allow significant increases in industry productivity for the benefit of all project stakeholders.

Traditionally, there are three methods to achieving software interoperability: developing point-to-point data translators; mandating the use of proprietary tools across an industry; or establishing neutral data standards. The structural steel industry is successfully promoting the implementation of neutral data standards, since they work as translators across platforms and offer stability in the representation of information. Point-to-point customized integration requires an expensive pair of interactive systems to provide a dedicated solution. Proprietary solutions are often used in large supply chains dominated by an original equipment manufacturer that mandates supply partners conform to a particular software solution.

The structural steel design and fabrication industries use the CIMSteel Integration Standards/Version 2 (CIS/2) neutral file format to achieve interoperability. Endorsed by the American Institute of Steel Construction (AISC) and recognized by the International Alliance for Interoperability (IAI) and other industry groups, the CIS/2 protocol converts project data into stable and uniform information, which is essential for long-term data archiving and retrieval.

The development efforts for standardized construction information led to CIS/2, which has bridged the use of previously incompatible platforms throughout the structural steel industry. The interoperability of CIS/2-compliant software enables collaborating firms to maintain logical relationships between the different types of design models, including those used by structural engineers, steel detailers and steel fabricators. The neutral-file format allows stand-alone programs—such as structural analysis and design, detailing and manufacturing information systems, as well as CNC driven fabrication equipment—to communicate with each other by translating a program's native format into a neutral format to allow data interchange across multiple platforms.

Essentially, CIS/2 is agile and robust enough to organize everything from connectors and materials to loads and frames resulting in a simplified process and significantly reduced costs in the structural design phase.

Interoperability Benefits for Steel Design, Fabrication, and Erection

While CIS/2 interoperability offers the most value when applied early in the design process, it also minimizes the schedule and cost impact of significant changes made later in the design process. In the days before CIS/2 interoperability, late design changes caused significant delays in the schedule due to the process of converting those changes from design to approved details and then manufacturing the components.

Lawrence F. Kruth, P.E., engineering & safety manager at Douglas Steel Fabricating Corporation in Lansing, Michigan, explains that electronic sharing of detailed project data early in a project will also provide more time for the building team to make sure the details are right and owner requirements are met. "The architect and engineer have much more time to pass the design back and forth and to refine it to the owner's needs. They can make sure the model goes out 100 percent correct. That's because the computer transfers everything now, eliminating the time spent on manual re-entry of data. All of us have more time during the initial design to coordinate efforts, which minimizes bulletins and changes down the road. Every time there is a change after the conceptual design process, the owner loses money on labor and sometimes on material."

Once a conceptual design is approved, architects assume a coordination role, gathering additional input from owners/operators and spending time at the site to ensure contractors are following design plans and that budgets remain intact. But before construction begins, the engineer, general contractor, steel fabricator and detailer must work together to finalize the structural design and fabricate the steel components, which is when CIS/2 interoperability is most valuable.

"Before interoperability, the process was the architect would present a defined building concept to the structural engineer who would design the structure utilizing a structural analysis program, prepare design documents and submit to the fabricator," said David I. Ruby, P.E., S.E., principle of Ruby & Associates, PC, in Farmington Hills, Michigan. "The fabricator would take this submission and have a material specialist prepare a full take-off by hand to determine the material required to build the structure. The fabricator would review all of the material from the engineer—page by page, sheet by sheet, floor by floor. They'd take a yellow crayon to mark off every beam, and another person would re-check and mark with a red crayon indicating it was checked again so the fabricator knew that the shop bill accounts for all the materials. Manually, this process took a week or more. And we're not talking just 40 hours of labor, but two or three people putting in 40 hours or more to pull that all together. With interoperability, this process takes just a few hours. We can now send files at noon and by 3 o'clock, the fabricator has the bill of materials to order."

Another time saving advantage is that CIS/2 interoperability of software allows "multiples" to be calculated by the fabricator's software system. "You always want to purchase material at the best cost, and the best cost comes by purchasing mill material which is normally rolled and/or stocked between 40 and 60 feet long. So you have to multiply it," said Ruby. "That means if you need three 18-foot beams, you don't order those exact pieces—you order one 55-footer and cut it to length in the shop. All of those calculations used to be done by hand."

According to Blower, project schedule compression is an important benefit offered by CIS/2 interoperability. "Even with design drawings being sent intact, there are always going to be questions and those can be answered in hours instead of weeks. The structural engineer works directly with the fabricator instead of the traditional Request for Information (RFI) process where hard copies are mailed back and forth. I'd say you lose three or four days for each RFI submittal."

"Reduced schedules allow owners to get buildings built and occupied faster, resulting in accelerated revenue streams and higher return on investments," said Blower. "And the time saved in the final design to fabrication process will often offer the engineer the flexibility to investigate more innovative solutions that drive additional cost savings."

Interoperable software is also useful in producing a clear-cut electronic data transaction record because files are date/time-stamped so all parties can easily identify the most current model. In addition, by importing directly from one machine to another, the engineer is assured the design will not be changed going forward into fabrication and the fabricator can be assured that files received from the structural engineer are accurate. This is of utmost importance because design errors will result in significant costs once the fabrication of building components starts.

"Clash detection is extremely important because fabrication errors result in costly erection problems that kill a schedule," Blower said. "Drawing completeness and detail accuracy are critical factors for efficient fabrication and erection. For example, steel beams for an elevator shaft must fit together properly and require exact positioning to allow room for other elements, such as plumbing and building mechanicals. However, if the materials are manufactured from designs with errors, this will cause significant challenges for the specialty contractor doing the installation. "It is much more economical to find dimensional errors and/or omissions during the detailing process than it is out in the field during erection. Interoperability facilitates more time up-front to identify and eliminate dimensional or other detail errors during the detailing process."

The Future of Interoperability for Building Construction

The structural steel industry has taken the lead in establishing working standards for the portion of design and construction dealing with the structural frame. The CIS/2 interoperability standard has been implemented in numerous software packages, and projects being built today are benefiting both in terms of reduced costs and accelerated schedules. But what comes next? Clearly, the step beyond CIS/2 interoperability is developing highly detailed information databases that store both material and structural properties for almost every element of a building.

This advanced technology is called Building Information Modeling (BIM) and it manages much more than graphics, but also information that allows the automatic generation of drawings and reports (i.e. quantities, cost, schedules, bills of material), extraction of analysis data (i.e. structural, cooling loads), interference detections, schedule simulation and facilities management. All this information is stored in a relational database developed to help the building team make the most informed decisions possible. BIM technology will support a managed environment to effectively share this information throughout the building life cycle, thus eliminating data redundancy, manual reentry, data loss, miscommunication and software-to-software translation errors.

BIM technology is much more than geometry or a detailed 3D model. Instead, it presumes a single, integrated database of information about every aspect of a building. Every element in a building information model functions as an "intelligent" object with established relationships to its surroundings. This allows designers and builders to identify all attributes of a building element, such as a steel beam, ventilation ducts or a chiller tower.

"For the steel industry, BIM technology defines the entire beam attribute," Ruby said. "Every piece of steel represented in the design software tells you everything about that beam—the color, what it is, how to put up, if it's available today. All of this is rolled into one model so a structural engineer can click on the beam, mark the date and check the length, load, type of beam, whether it needs fire protection or not and the type of prepping required. I can learn all this just by clicking on one beam."

According to Ruby, BIM's extensive knowledge sharing completes the "big picture," making clearer all the requirements for a building project. "The primary benefit of interoperability is to integrate design and construction processes and eliminate the need for manual reentry of data. But BIM technology gives the team a holistic point of view of the project—we can have all information in one place, and it can be shared among the team seamlessly." Today's CIS/2 interoperability standard will integrate fully into the BIMs of the future.

Owner/Operator Responsibility

The use and development of interoperability has accelerated in recent years, but to take full advantage of this opportunity to maximize efficiencies and reclaim the $15.8 billion in waste, owners/operators must mandate that interoperable technology be implemented at all stages of their projects by all designers, contractors, suppliers, and specialty contractors.

A reason for owners/operators to usher in interoperability as the standard protocol is that it adds a layer of accountability to the process, forcing collaborating firms to be more forward in explaining project costs. In fact, according to the NIST study, industry experts estimate that approximately 85 percent of owners/operators in the capital facilities industry are largely uninformed on issues related to project costs. The reality is, they must rely on the integrity of architects, engineers, and general contractors to keep projects within specified budget constraints.

With BIM and interoperability, the creation of a centralized database in a common language can help explain the charges more clearly. From multiple change orders to excessive RFIs, owners/operators can monitor this activity and evaluate how it affects the project's total cost. This is especially useful for bigger construction projects that often have many specialty contractors sharing information and designs. This approach ensures team members operate more efficiently and remain organized while minimizing management costs to oversee the project.

For these reasons, owners/operators must encourage continued development and implementation of additional interoperability solutions like CIS/2. This will require owners/operators to engage other industry stakeholders and negotiate an agreement among them to achieve industry-wide interoperability. Such work is being pursued by FIATECH, a non-profit consortium focused on fast-track development and deployment of technologies to improve how capital projects and facilities are designed, engineered, built, and maintained (for more information, visit www.fiatech.org). FIATECH has developed the industry's first-ever capital projects technology roadmap, which delivers a formal framework to help identify technologies that address the industry's most pressing challenges, guide industry-related research and development efforts, and shape the consortium's own work. FIATECH members include owners, engineering/procurement/construction (EPC) firms, suppliers, technology developers, universities, and other research institutions involved in the capital facilities industry.

CURT, the Construction Users Roundtable, whose members identify themselves as the "owner's voice to the construction industry," have developed a white paper urging owner leadership of integrated project structures utilizing open information sharing and virtual building information models. The paper, entitled "Collaboration, Integrated Information and the Project Lifecycle in Building Design, Construction and Operation," is intended to be a framework for articulating new policies, procedures, and standards for the construction industry (for more information, visit www.curt.org/14_0_curt_publications.html).

Another owner-led effort is looking to establish a BIM standard for the building industry. The U.S. General Services Administration's (GSA) Public Building Service has contracted with the International Alliance for Interoperability (IAI) North America to help smooth the BIM transition. These groups have set a 2006 target date to start using building information models based on Industry Foundation Classes (IFC), the data model managed by IAI, to create systematized, easily usable data storehouses that can go well beyond 3-D modeling to handle cost, schedule, fabrication, maintenance, energy, and other information across facility lifecycles. The GSA-IAI effort will address BIM data needs, IFC-compliant software, gaps in the data model, and barriers to implementation.

"GSA is taking the lead here in the effort to define a single standard for building information," stated National Institute of Building Sciences' technical programs director Sandy Shaw in a September 22, 2004, press release. Shaw said the new team hopes to bring other government agencies, private owners, and professional groups into a "coordinated dialogue" (for more information, visit www.iai-na.org/news/092204.php).

What are the costs today for a project owner or developer for mandating the usage of CIS/2 interoperability on a project? The structural engineer's fees associated with the design of the steel frame will increase as a result of the additional professional services required to maintain "model discipline" throughout the entire design phase. However, the reduction of detailing and fabricating costs will more than offset the additional engineering fees. Ultimately, owners and developers will save money with CIS/2 interoperability.

The Next Step

With inadequate interoperability costing the construction industry—including owners/operators—in excess of $15.8 billion annually, a sense of urgency to take action is needed. Certainly, there are segments of the industry, such as steel, that are progressing but the movement must continue to build momentum. Resistance to the use of more sophisticated technologies as well as the lack of trust that is inherent in any fragmented industry must be overcome in order to realize the productivity gains that other industries are experiencing. However, after years of attempting to educate designers, contractors and subcontractors, there is still only limited usage of this technology.

Today, in order to accelerate industry-wide development and acceptance of interoperability, owners/operators as well as project decision-makers will need to mandate its use on their projects. Only then will the fragmented design and construction industries mobilize to take action.

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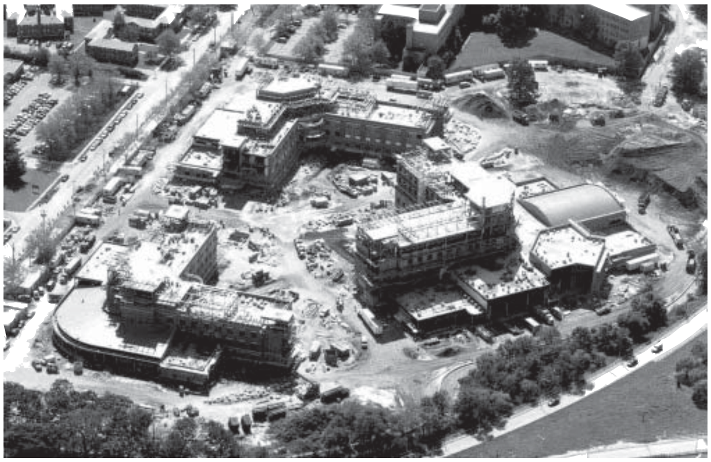
Case Study:
3 Schools + 2 Years = 1 Team

Summarized from *Modern Steel Construction*, October 2003.



The Glen Oaks campus in Queens, NY, consists of two grammar/middle schools and one high school. The grammar/middle schools are both four-story, 1000-ton steel frames, each approximately 125,000 sq ft. The High School for Teaching Professionals is a six-story, 1,500-ton steel frame, approximately 225,000 sq ft.

A design-build approach was chosen for the Glen Oaks Schools project for speed and economy. General Contractor, Leon D. DeMatteis Construction Corporation, of Elmont, New York, led the design-build team and the bid process began in early April 2001, using preliminary architectural design documents. Steel fabricator, South Carolina Steel, joined DeMatteis' team shortly thereafter to help create the proposal.

Architect John Ciardullo stated the fabricator's presence at the start of the project was crucial. "What happens is, each fabricator works a certain way. Some like bolted connections, others like welded. You can talk to them about the framing system and how you want to handle it—how to phase, sequence and build the project, so you can start the shop drawings."

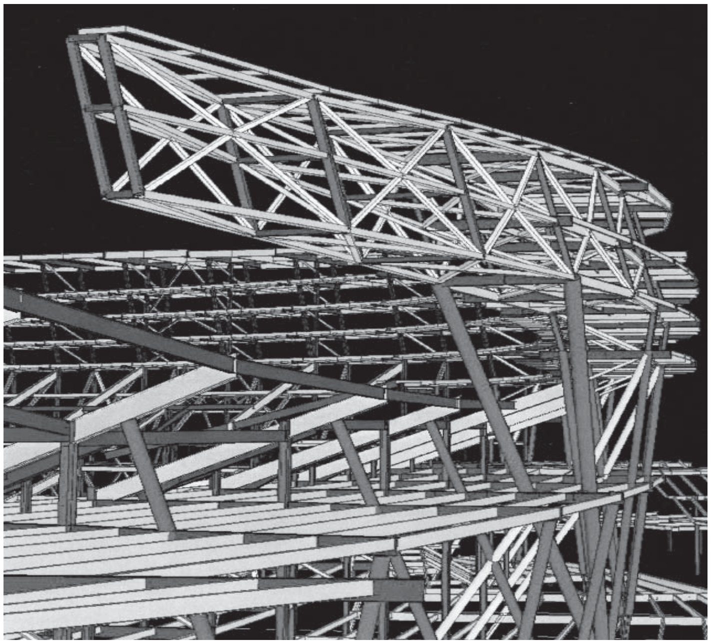
Engineers used RAM Structural System software for structural design. "RAMSteel provided us the flexibility to accommodate the constant changes to mechanical openings, beam locations and braced-frame locations," said Ryan Summey, P.E., project engineer for Cary Engineering. "The software also provided an excellent organizational tool for design calculation submittals."

Structural information was communicated to the detailing teams with the interoperable CIS/2 file format for downloading of the structural information to perform detailing work using SDS/2 detailing software. 3,500 tons of structural steel and 500,000 sq ft of metal deck were erected simultaneously through the winter months, and substantially completed in April 2002, at the rate of approximately 700 tons and 100,000 sq. ft. of deck per month.

To read the full story behind this project, visit www.aisc.org/glenoaks.

Case Study: Stadium Engineer Drives Toward Paperless Project

Summarized from *ENR*, April 14, 2003.



Chicago's Soldier Field's $365-million makeover was a "paperless" project of monumental scale never before seen in the United States, but this was the only option to meet the task of gutting and reconstructing the landmark sports facility in four to six months less than what is customary for National Football League stadiums.

The need to fit the new 61,500-seat bowl snugly into the historic colonnade structure also drove the decision to use a 3-D approach. "If you can model it in 3-D, you can build it," says Joseph G. Burns, principal in charge for project structural engineer, the Chicago office of Thornton-Tomasetti Engineers.

To make this happen, Burns created a 3-D model of the 13,000-ton structural steel frame and shared it with the steel fabricator to drive its computer numerically controlled (CNC) fabrication equipment. A 3-D model wipes out the need to create shop drawings, a process vulnerable to human error. Instead, the steel detailer simply enhances the engineer's design model by adding all the elements, such as bolt holes, bolts, angles, and plates required for fabrication and erection.

This interoperable process minimized requests for information and reduced the time to answer them. The engineer then approved the detailed model and the fabricator used this to produce the steel members soon thereafter, allowing the team to meet aggressive deadlines.

"The 3-D model was used as a means of communication between the design and construction team from design development onward," says Burns.

To read the full story behind this project, visit www.enr.construction.com/features/technologyEconst/archives/030414.asp.

Case Study:
Dream Team

Summarized from *Modern Steel Construction*, October 2003.

Renovation of Presbyterian Hospital in Albuquerque, NM, used 1,200 tons of structural steel to add 150,000 sq ft to the building. Although the hospital originally was designed for an additional three levels, the existing structure was built to an older building code. "Because of the more stringent seismic criteria in the current building code, it was necessary for us to modify the steel braced frames and a number of columns," said SER George H. Bradley III, P.E., a principal with Chavez-Grieves Consulting Engineers, Inc.

The hospital hired McCarthy Building Companies, Inc. as a construction manager and general contractor. Dekker/Perich/Sabatini, an Albuquerque-based architectural firm, was brought on board as the project architect, with Chavez-Grieves as their structural engineering consultant. "At that point it became a design-build project," Bradley said.

The decision was made to bring AmFab, Inc., a structural steel fabricator, onto the project team so to benefit from fabricator involvement in the design process. RAM Structural System software was used to create an accurate 3-D model of the entire project. The model contained both the existing structure and the new construction. "Using this design model, we were able to analyze both the new and existing structures, design the seismic upgrades for the existing system and design the new construction," Bradley said.

"We used EDI and the CIS/2 translator to have the two programs talk to each other," said Mark Mosher, managing partner for AmFab, Inc. "You can imagine, we already have a 3-D computer model built in the structural analysis software and we use the CIS/2 translator to pass this information to the SDS/2 detailing software. The effort that would have been required to create this model in SDS/2 from scratch would have been tremendous—it would have taken hundreds of hours to recreate. Passing information between software applications with the CIS/2 translator is a huge advantage."

To read the full story behind this project, visit www.aisc.org/hospital renovation.

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