CONSTRUCTABILITY – NOW MORE THAN EVER!

Applying the philosophy of constructability into your projects will garner numerous benefits.

BY DAVID I. RUBY, P.E., S.E.

DO YOU EVER ASK YOURSELF, "Why did I choose this industry?" Your answer is probably similar to others reading this magazine. Perhaps as a child, you enjoyed erector sets and taking your mother's toaster apart. Perhaps you loved going to the steel mill with your father and couldn't imagine not being involved with an industry that built such important structures.

For me, it was growing up in a small town outside of Pittsburgh, surrounded by what, at the time, was a thriving U.S. steel industry. Upon graduation from high school, I began my career as a steel detailer, where I learned the importance of accurate and coordinated details and began developing a passion for constructability as a design philosophy.

con·struc·ta·bi·li·ty
\kən-ˈstrək-tə-ˈbi-lə-tē\ *philosophy*

The integration of construction knowledge and experience in planning, design, procurement, and construction of the project consistent with overall project objectives.

Constructability

Constructability provides all the elements that attract designers and constructors to the industry; that feed our desire to create and build; that fuel our excitement and generate enthusiasm in our daily lives; that engage us in developing solutions for those nearly impossible situations; and that allow us to express our dedication to the safety and welfare of the public. In short, constructability facilitates the desire to be creative, to help mankind, and to leave the world a better place.

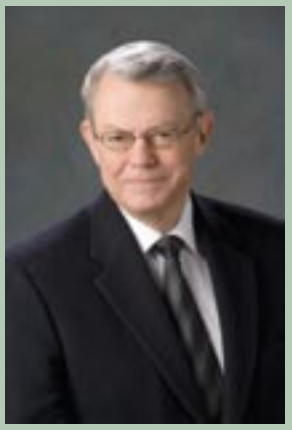
My construction knowledge and experience, the root of my constructability philosophy, were gained through hands-on experience as an engineer for the American Bridge Division of U.S. Steel Corporation. During my 10-plus years at AB, I was immersed in and exposed to all aspects of the steel industry: shop detail drawing preparation, connection design, fabrication procedure development, weld design and quality, erection stability analysis, and procedure development. I developed shop fabrication procedures and assisted shop personnel in preparing quality control procedures. And I often discussed installation and rigging concepts with ironworkers at jobsites on a variety of projects such as the New York World's Fair Unisphere, the Tagus River Bridge in Portugal, the Astoria-Megler Bridge in Oregon, San Francisco's Embarcadero Hyatt Hotel, and the Aon Center, John Hancock Building, and Sears Tower in Chicago, to name a few.

While thus engaged, I developed an understanding of structural steel as a building material, as well as an appreciation and respect for the tradesmen and their skills. I became familiar with the equipment used in the steel construction process and expanded my grasp of site constraints and limitations and their impact on that process. Following my career at AB, I served as the chief structural engineer for John Portman & Associates in Atlanta, where I honed my design philosophy by focusing on structural framing concepts that could be built effectively and efficiently. All of this experience, along with seven more years serving as the director of engineering for a design-build contractor, enabled me to begin my own structural consulting firm and put this knowledge and experience into practice.

While many design professionals may know what makes a project "constructable," additional benefits can almost always be derived from the involvement of an industry professional. The constructability design philosophy, when incorporated into the planning and conceptual stages of a project, provides for a more informed decision-making process based upon up-to-date costs, material availability, framing options, and other value-engineered solutions. In addition, design document reviews, subcontractor qualifications, site constraints, weather impact, and schedule concerns can be evaluated earlier in the process when construction-related options and alternatives are included in the decision matrix.

While constructability is typically associated with reviewing design documents only when budget issues surface, this is just the tip of the iceberg; oftentimes, such reviews are performed too late in the process to realize real benefits to clients, consultants, and contractors.

Sophisticated facility owners, having benefited from constructability reviews in the past, are now beginning to realize the need for constructability within the design and construction process—and not just as it relates to money. These owners recognize that construction



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knowledge included within the design matrix, even at higher initial design costs, makes for drastically reduced schedules, lower construction costs, fewer change orders, and lower facility maintenance costs.

Constructability as a design philosophy promises the following:

- ➜ Construction knowledge and experience will be infused into the design from initial planning through construction.
- ➜ Design and construction teams should be integrated if you want to achieve the most effective design.
- ➜ Enhanced cooperation, reduced costs, an improved schedule, and minimal litigation.
- ➜ A finished facility that exceeds owner expectations.

Used optimally, the constructability design process allows the design team to visualize the construction of a project prior to beginning the actual design, and to maintain that vision throughout the process. This approach maximizes simplicity, economy, and speed of construction while considering such project-specific factors as site conditions, code restrictions, and owner requirements. Beginning in the planning process, maturing during the conceptual design stage, and continuing through final design, the constructability design process links project planning with design and construction.

Remember: Constructability is a design philosophy, not a single, one-time event. It is a philosophy that incorporates the following into the design delivery process:

Visualization of clients wants and needs; of the architectural program, including M/E/P sytems; and of structural options, alternatives, and installation considerations.

Innovation/imagination, resulting in a clear, concise project vision of concept, attributes, and constraints; and clean-slate concept development with designers who actively seek and incorporate construction input.

Collaboration/coordination between designers and constructors, as well as designers and construction trades.

Maintenance, because those involved remain focused on the vision through collaboration and coordination.

Enter BIM

With the advent of BIM, constructability has become that much more critical. BIM is not just a combination of design technologies that represent every building component in a virtual environment, nor is it merely a 3D rendering of a building. Rather, BIM is a radical departure from the traditional design delivery process. BIM, as a delivery process, provides the construction community a complete 3D database that can be downloaded for estimating, scheduling, detailing, advance bill production, automated shop drawing, and construction planning for all of the trades. In short, BIM is a means to communicate a complete project delivery concept developed with constructability as the design philosophy.

While constructability is the philosophy that allows everyone on the design team to participate throughout the process, BIM is the tool that provides the means to communicate the results of our cooperative and collaborative efforts. Through the combination of the two, the construction process can be visualized and coordinated. Constructability, when introduced into the design process, provides the information necessary to achieve the early definition of the structural system. Such an infusion of construction knowledge allows for the initial coordination with other materials, earlier and more accurate estimates of cost, refined schedules, and the development of necessary sections and details.

Such a collaborative interface between design and industry professionals greatly increases efficiency and quality. And although traditional roles will continue to exist, constructability-enhanced BIM will begin to blur the relationships between designers and constructors, as constructors become active members of the design team engaged in the collaborative development of the final solution.

Practical Application

Ultimately, this marriage of concept and technology seeks to integrate the design and construction process and reap the benefits of collaboration. These benefits aren't too shabby: Research from the Construction Industry Institute indicates that cost reductions of at least 6% and as high as 23% are possible, with benefit/cost ratios as high as ten to one.

But how can we, the design professionals, best achieve these results? How can we improve the process? How can we infuse construction knowledge and experience into our design process? How can we begin to fully understand the steel construction industry and how our design decisions impact it?

For starters, we can become more active within industry organizations such as, AISC, ACI, PCI, and others. We can attend industry conferences, such as the North American Steel Construction Conference, and better utilize the resources available to us. We can explore innovative ideas with industry professionals on how to gain the advantages of steel-framed construction or how to successfully develop a composite construction option on our next project. We can explore how other design professionals, owners, and general contractors have successfully incorporated constructability on similar projects, saving time and money. We can become knowledgeable about the relative costs of various materials or framing options and the benefits and advantages of using various materials.

We can also develop a relationship with a structural steel industry professional. Invite an industry professional to your office. Include them in your project discussions, openly discuss the design criteria, brainstorm framing options, review the project construction constraints, and explore framing alternatives and connection options. In addition, visit fabrication shops and jobsites. Watch the activities, including receiving, fabricating, cleaning, painting, loading and unloading, lifting and setting, and finally, bolting and welding. Ask questions about the process, about connections, about good and bad details, and about fab shop "do's and don'ts."

Finally, consider utilizing CIS/2 interoperability on your next project. Contact a local fabricator and explore the options available through the transfer of your 3D design model to the fabricator's shop detailing program. Consider reviewing the design via computer, without the traditional submittal of countless shop drawings. In doing so, you will be able to identify and confirm the critical connections and members on the screen, rotate the model, view the members and their connections, visually confirm that the connections meet the project design requirements, verify the main material sizing, and make any necessary notations or comments on the screen before the fabrication process.

Through this process you will be able to respond faster, reduce cost, save time, and improve communication. In addition, your visualization of the structure will be enhanced. This will prompt constructability issues to surface, and their solutions will improve and enhance your final product: the client's building. MSC