FACILITATING ESTIMATING

Increasing value with a conceptual cost-estimating checklist.

BY TABITHA STINE, S.E., P.E.

TOO OFTEN STRUCTURAL ENGINEERS fall into the trap of designing a project based simply on the weight of the frame rather than considering the entire project. But thinking strategically about structural engineering is integral to adding value and generating future business for your firm.

While some structural engineers are content to design an efficient frame that minimizes weight, others realize the process is much more involved. Is the frame easy to fabricate and construct (which impacts both the cost and time of construction)? Does the design easily accommodate the mechanical system? What's its impact on foundations and façade attachment?

> The more collaboration and research done to hone in on specific project factors —and how they affect other decisions— the more accurate the conceptual estimate will be.

Why is conceptual estimating important to structural engineers? Simply put, the more value a structural engineer can bring to a project, the more in-demand they'll be.

The structural engineer should step up to be the facilitator in conceptual estimating. A good conceptual estimate is a team sport, one in which a collaborative group of people are willing to explore hypotheticals, discuss implications with other trades and share historical cost and schedule data. Even when the engineer leads the discussion in how these items impact the project, they can't answer everything on their own. The most successful projects include open communication and collaboration between all decision makers.

Too often we depend on rules of thumb we've developed during our career and information on other projects we've completed. Unfortunately, these numbers often do not reflect current market conditions or construction techniques. So what should we be doing?

On every project, the team should start with a checklist, such as the one that follows, to determine the path to the best solution. While this list is not comprehensive, it's an excellent starting point. As you gain more experience with conceptual estimating you'll be able to fine-tune the list, adding or subtracting questions.

Is the framing system structurally efficient and economical for this project?

It's important not to focus solely on pounds per square foot (psf), as is traditional for an S.E. The biggest value a designer can bring to the process is to stop talking solely about psf and start talking dollars. Remember that least weight is *not* always least cost in member, connection and floor design/layout. Does the chosen psf make sense as the more economically efficient system against other projects? Does the design address the most economical solutions for deflection, vibration and sound transmission? Does the specification include the most readily available materials currently produced (for a list of these for structural steel structures, go to **www.modernsteel.com/materialspecs**)? Have field connections been minimized and does the design use as many shop connections as possible to reduce costs (and has the local fabricator been asked "bolted vs. welded?") as well as consider other potential cost reductions as showcased in the article at **www.modernsteel.com/detailsavings**? Are the contractor and available labor force familiar with the material and chosen construction method?

Tabitha Stine is AISC's director of technical marketing. You can reach her at **stine@aisc.org**.

Are there construction schedule limitations due to a fixed opening date?

Time is of the essence. Value can be brought by selecting a system that can speed up the construction time line and allow more time for other trades to get on the job sooner and possibly reduce overall general conditions costs. How do all of the decisions impact the project schedule? Has a Gantt chart been reworked to evaluate the best approach to streamline the project to save time and money?

What is the controlling building code on the project?

Understanding the structural design criteria is important. But what does the code say about fire protection requirements, use of innovative or proprietary systems, egress and accessibility or sustainability goals or requirements (which can all have cost impacts depending on how they are addressed and managed)?

Are there constraints for lay-down space or cold weather limitations for construction/erection?

Without adjacent site space for subassembly of pieces, construction staging can be quite difficult and expensive. Closing streets, renting adjacent sites and even working in the winter can all cause increased general conditions costs and economic challenges. Explore more pre-assembled options such as truss assemblies (consider a staggered truss that can be erected by a crane directly from the trailer), modular construction of entire floor system panels and working with more hollow core plank and steel in areas where erection will be taking place in the winter.

What are the current material pricing trends for the construction materials?

In developing a conceptual estimate it is best to note that the structural steel package is approximately 10% of the entire project cost. The material portion of a steel framing package will be only approximately 30% of the overall steel package and a 5% variation in material prices will result in a 1% to 2% change in the cost of the steel package. In the same way, it should be recognized that fabrication and erection prices vary over time and that if a project is significantly delayed between the time of design and construction, all project estimates should be updated. Understanding the current material pricing trends for structural steel—as compared to products such as ready-mixed concrete—and also considering the costs of fabrication and erection compared to the labor costs of placing and formwork for the concrete system is vital. The AISC Steel Solutions Center tracks this information for the steel industry and you can receive a copy by reaching out to us at **solutions@aisc.org**.

What are the required floor-to-floor height, usable square footage per floor, future expansion needs or façade constraints?

The framing system and floor/deck selection cannot be economically optimized without consideration of these items. Can the S.E. recommend an innovative system that is outside the box? Can there be more efficient braced frames on the perimeter or do the window systems limit the design to more costly moment frames externally and braced frames at the core? Does the project need to be able to expand up or out in the future—and how will that be handled? Can the MEP systems run through openings in the steel webs to reduce the floor-to-floor heights and save façade and elevator costs with a shorter structure? Has the most efficient bay framing been selected for reduced piece count to reduce erection time and costs? Are the spans optimized to bring more flexibility to the tenant's space with fewer columns, which can help the owner have a more economically attractive space to lease? Have these considerations all been measured up to the same challenges in the concrete framing system?

The value of conceptual estimating is only recognized when all material options are compared in an apples-to-apples environment.

Which foundation type should be used based on soil conditions and current/future loading needs?

A steel-framed structure can weigh up to 20% less than a similar concrete-framed structure. Also, longer spans could require fewer column locations or footings. Poor soil conditions also should be noted early on to anticipate how best to reduce the overall foundation cost. Framing system selection should also consider these foundation implications.

How do the project team's contractual relationship and delivery approach impact the costs?

Will building information modeling (BIM) be used to integrate various trades early on to preclude normal on-site clashes or for the full delivery of the design deliverable? Can 3D shop drawing review (**www.aisc.org/modelreview**) be incorporated to save time in the review process, which will give schedule slack back to the owner and save money for the team? If there isn't a design-build or BIM approach to the job, is there a collaborative project team that is vested to sitting down and having an open dialogue with one another to avoid as many conflicts and constraints as possible throughout the project life?

Does the contractor's cost per sq. ft of the structure look at comparative material package options as apples-to-apples or apples-to-oranges?

The value of conceptual estimating is only recognized when all material options are compared in an apples-to-apples environment. Don't compare a steel frame to a concrete frame; rather, compare the entire building (including the frame).

Many of the questions/considerations above are based on early discussions with the entire project team—with input from respective subcontractors and trades. Early collaboration is a necessity to ensure that the best decisions are made for the project. The more these items are discussed and handled early on, the more money the project will save. Every project will not have partners that are open to sharing—or are contractually set up to easily facilitate sharing. The S.E. needs to highlight which items in their conceptual estimate may be unknown, assumed or require clarification by a subcontractor at a later date. This challenge reinforces the need for the S.E. to keep their own sources of cost information outside the confines of the project. It's unlikely that anyone has the answer to every concern, but by facilitating discussions early on the team will be more capable of handling them as the project moves forward.

Improving Estimating Skills

As a tool for future projects, all the items in the checklist should be considered for future use. By categorizing the above information in a spreadsheet with the project information (including project name, location, number of stories, structure usage, team members, budget information, bid pricing and final costs) you will be able to use the information for comparison and checks on future jobs.

Using the steps above, a good conceptual estimate can get you to within 8% to 12% of the final project costs. Obviously, the more collaboration and research done to hone in on the specific factors (and how they affect other decisions), the more accurate the conceptual estimate will be. The time involved varies based on the complexity of the project.

Here are some suggestions for taking the dive into *proper* conceptual estimating:

- The AISC Steel Solutions Center (**solutions@aisc.org**) is available to provide ideas for optimal steel framing solutions for projects. Prototypes are available to provide efficient steel layouts and cost-effective approaches for various project challenges at **www.aisc.org/myproject**.
- The best resource is the development of an in-house parametric spreadsheet of all captured project information, including estimates and bids for previous projects. Future estimates will directly benefit from this historic information.
- Invest in technology that enhances the estimating process. Using analysis software to run various iterations of different bay framing sizes, lateral systems and different materials—with the capability to quickly export the piece count/material specifications into an estimating software package—will help streamline the process. To gain the confidence in the estimating software's results, spend time checking it against past projects and assumptions before using it on a "real" job!
- Continue to collaborate with subcontractors and other project team members. Understand their decision-making process and what efficiencies can be gained when interfacing with them early on.
- Subscribe to resources that discuss not just the structural aspects of a project but also the cost implications. *Design Cost Data* (**www.dcd.com**) is one such monthly publication that publishes project costs by division for a variety of project types.
- Use common sense. Always take a step back and ask yourself, "Does this make sense?" Think of the process as a continual review of how each facet of the project changes through the design and construction cycle and how the subsequent trades are economically impacted.

Remember that a conceptual cost estimate is not just a number. It is necessary to always explain your assumptions, scope and limitations within your conceptual estimate. The structural engineer can bring great value to the project by approaching every project with the mindset that this is an opportunity to provide the owner with a better project that is completed sooner at a lower cost.

On projects in today's recovering market, clients are looking for efficiencies at every turn. Stand up and show the value you bring to the table by showcasing your skill set in conceptual estimating—and the process you take to bring value and money back into their projects. MSC