Conceptual Estimating, Design-Build and the Steel Fabricator

William Liddy and John Cross, P.E.

By mastering the concept of conceptual estimating, steel fabricators can form relationships with owners and developers in the earliest stages of a project.

You are at lunch with a local developer and several members of her staff. She spends 10 minutes excitedly talking about a new four-story office building that she wants to build on a parcel of land she owns. She turns to her director of development and he madly sketches his vision of the project on the back of a napkin. Members of her staff chime in with ideas. And then she asks the big question, "How much will it cost?" The table falls silent. All eyes turn to you, the steel fabricator. And you say…

What would you say? Would you tell her that mill cost of a ton of steel is only $430? That fabricated steel for an office building today is around $1600 a ton? Or that a four-story office building usually has about nine pounds of steel per square foot of floor space? Guess what…she wouldn't care!

Would you tell her you only work with steel, and that she'd have to talk to an architect and a general contractor to get a price? You'd miss getting in on the ground floor and influencing the project!

Do you let it end there? Hopefully not! This is your chance to look her in the eye and let her know that you've worked as a team with local architects, general contractors and structural engineers, and you'd like to bring them in to meet her and discuss the project. You'll help her define the scope of the project; the team will give her an estimate that is representative of its actual cost.

You know that this is an opportunity to get your foot in the door. You can influence the project design to match the efficiencies of your shop. You'll be able to avoid change orders and negotiate your price. You'll be part of a design-build team, and together you'll construct an office building that will accelerate the construction schedule, save the developer money, and put a smile on her face.

But you need to put together a number for the steel now. Before detailed structural plans are completed. And you'll need to live with it as a maximum guaranteed price. Welcome to the world of conceptual estimating!

WHAT IS IT?

Jeff Beard, President of the Design-Build Institute of America, defines conceptual estimating as "the skill of forecasting accurate costs without significant graphic design information (sometime no graphic design information) about a project." For the steel fabricator, conceptual estimating is the skill to look at the performance specifications and footprint of a structure and develop a budget for all of the activities relating to steel in the structure: detailing, fabricating, painting, transporting and erecting.

Conceptual estimating is not just making a good guess at the cost of the steel in a project. It is listening to the owner and understanding the project's goals. It is understanding structural systems, assemblies and their costs. It is comprehending the price of steel, not when it leaves the fabricating shop, but when it is in place on the structure. It is the search for a more efficient and productive way to manage the steel process. And it means clearly defining the scope of your work for the amount you are proposing to charge.

Everything takes time

Each progressive level of conceptual estimation requires more time and effort to complete. The structural steel fabricator can easily over-invest staff hours in preparing conceptual estimates. The basic rule of thumb should be that the amount of effort to prepare the estimate should be proportional to the level of information and performance specifications available to the fabricator. Typically the amount of time proportionally invested for each type of conceptual estimate is:

- feasibility estimate 1 hour
- performance estimate 4 hours
- conceptual design est. 10 hours
- detailed estimate 40 hours

Conceptual estimating is the skill of costing a project from the view of the whole project looking down, rather than from the details looking up.

IS A CONCEPTUAL ESTIMATE ETCHED IN STONE?

There are many stages of the conceptual estimating process: feasibility estimates, performance criteria estimates, conceptual design estimates, detailed estimates and life cycle-cost estimates. At each progressive stage the estimate should be better refined and contain fewer contingencies. That does not mean that every successive estimate will go down in cost. The scope of the project may change or be better defined, resulting in an increased estimate for the fabricated steel. In such cases it is critical that a change in scope be highlighted as the reason for the increase in cost. It is an old rule of thumb that "no estimate is ever forgotten!" and that is particularly true if subsequent estimates increase in cost. Each estimate needs to be fully documented and retained. The challenge for the fabricator is to track past project costs and organize them in a way that allows the creation of an accurate conceptual estimate in a minimal amount of time.

STAGE 1—FEASIBILITY ESTIMATES

The first stage of a conceptual estimate is a feasibility estimate. It is developed from very preliminary information, often the proverbial back of a napkin. The goal is to determine if a project's cost is justified by the benefit received from the completed structure. No design effort has yet begun, and if costs come back too high, there will be no project.

A feasibility estimate gives the fabricator a chance to address potential project solutions, such as the savings possible with steel as compared to concrete framing systems. A project might not be feasible using a particular building type, but could become feasible as alternative materials and design approaches are evaluated. A single project might have multiple feasibility estimates as the scope and performance requirements of the project change. At this level of estimating there are no contingencies and no allowances because the entire project is still unknown. Often it is best to provide a feasibility estimate as a range of probable values although the client will typically only remember the low end of the range.

STAGE 2—PERFORMANCE CRITERIA ESTIMATE

The second stage is developing a performance criteria estimate. The client has moved from sketching the project on the back of a napkin to a formal statement of the performance requirements of the project. This includes a site plan and suggested structural footprint. The conceptual estimator will begin to visualize the structure in order to generate the performace criteria estimate. The estimator needs to evaluate the effect of certain occupancies on the loads imposed on the structure; the impact of HVAC equipment on structural components; the impact of architectural concepts on connection design; and the impact of use classification on fire protection regulations. The estimator might base estimates on the square footage of the structure, comparative parameters to other recent projects, industry costing tools or price indices. Multiple approaches are applied to create a range of costs from which the estimate is generated.

It is also important to discuss potential contingencies with the entire project team. Contingencies for unknown conditions and scope changes should be carried in the overall project estimate, not in the estimates of individual specialty contractors. Fabricators should define the scope of the conceptual estimate. They also should indicate allowances for work performed by others or undefined work that will be required on the project.

STAGE 3—CONCEPTUAL DESIGN ESTIMATES

The third stage is the conceptual design estimate. 10% design drawings, general arrangement drawings, and layout and architectural drawings provide a base from which a representative structural design can be developed. Design loads, special structural considerations and architectural requirements must also be taken into account. These loads and considerations might not be assigned to their actual location in the structure, but will be considered in the general sizing of structural members and connections. From this preliminary structural model, take-offs can be generated to produce a typical material list, which can in turn be priced.

This estimate often is the basis of the fabricator's negotiated fee and design-builder's fee for the project. The assumptions and scope of the intended work must be well defined in writing. It is critical that the design-builder who submits the final proposal to the client is aware of allowances included in the fabricator's estimate, or possible miscommunication errors could result. For example, a fabricator might price all structural steel but not the miscellaneous metal, while the design-builder assumes that the fabricator will provide all steel.

As the owner modifies the project requirements and the design-build team changes the approach to the project, multiple conceptual design estimates might be necessary. The design-build team should log these changes and track the incremental cost of modifications to the overall project cost. The fabricator should maintain a similar log of the cost impact that per-

Feeling overwhelmed?

Developing your methodology, collecting historical data and producing conceptual estimates takes time and hard work. But conceptual estimating opens the door to design-build.

Involvement in design-build projects as a steel fabricator will:

- Allow you to negotiate your fees
- Increase your profitability
- Lower your risk
- Utilize the efficiencies of your shop
- Integrate your expertise into the final project design
- Create an effective working relationship between you and the structural engineer
- Encourage the use of new time saving tools like EDI
- Develop a long-term relationship with the project owner
- Accelerate the project and your shop time

formance requirement and design changes have on the structure.

STAGE 4—DETAILED ESTIMATE

Estimation does not end once the project fee is negotiated. When design work reaches the 50 percent level, a traditional detailed estimate should be performed. The purpose of this estimate, which is performed in the same way as a hard-bid estimate, is to authorize full funding for the project, to identify problems with the conceptual estimate, and to provide a cost-control budget for the fabricating and construction process. If there is a disparity between the detailed estimate and the negotiated fee, a fabricator can either propose alternative cost-saving suggestions to the design-build team or utilize the contingencies that the team built into the negotiated fee.

STAGE 5—LIFE-CYCLE COST ESTIMATE

The final estimate is used on design-build projects is the life-cycle cost estimate. Unlike the other estimates, the life-cycle cost estimate does not focus only on the cost to design and construct the project. It includes the original design and construction costs, financing costs (taking into account accelerated cash flows from early occupancy, and maintenance and upkeep costs over the life of the structure), renovation costs (particularly if different loadings might be anticipated), and the residual value or demolition costs at the end of the structure's useful life. These costs are discounted over time to determine the true value in current dollars of the project.

Life-cycle estimating involves predictive assumptions about the performance of the selected structural system that might generate uncertainty in the final cost estimate. However, this procedure is beneficial to weigh the relative benefits of comparative systems. When comparing competing systems, the use of consistent assumptions can minimize uncertainty. It provides a valuable comparison between a low cost, high maintenance structure and a high cost, low maintenance structure.

Each estimate should contain allowances to address 1)areas of risk to the fabricator and 2)items required by code or practice that are not yet defined.

HOW DO I DEVELOP ONE?

The quality of a fabricator's conceptual estimate depends on the quality of information provided to the fabricator. The more uncertain the provided information, the greater the variability in the estimate and the more allowances will be added to the cost of the project's steel. As project information is revealed, a fabricator should define key parameters. These parameters can then be referenced against a database of similar parameters that the fabricator has maintained on previous projects. This process is referred to as parametric estimating.

TYPE 1—PARAMETRIC ESTIMATES

The three most common parameters for a first estimate are 1)the type of structure, 2)the number of floors in the structure, and 3)the total square footage. These data points help the fabricator reference similar projects to determine an approximate tonnage of steel and associated cost. While many experienced fabricators can do this by memory, it is still advantageous to maintain a database of these parameters. The database can be a list of projects; their size, location, and number of stories; the number of tons of steel shown on the plans; the fabricator's bid; the winning bid for the project; and the final cost of the project. The list does not need to be computerized, but creating it on a computerized spreadsheet allows for easy sorting and categorizing of data.

Additional parameters to better define the project can be added to a database. These parameters might include gross floor area, footprint, roof area, exterior wall area, floor-to-floor height, HVAC systems, intended structure usage, special structure requirements, structural engineer, and governing building code. If the project has been previously bid or negotiated, and a hard take-off has been performed from the plans, it is valuable to enter as many details about the take-off as possible. This includes the number of pieces, connections, shear studs, bay sizes, and any additional information thatof value.

The larger the number of items that can be deduced from the client or design builder's information, the more accurate the projects' initial parametric estimate will be. As projects age, an escalating cost factor can be applied to earlier estimates to make them relevant for current projects. Data in a spreadsheet can be sorted and viewed in different orders. Different ways of looking at the project produces different cost ranges, which can then be compared to determine a target value for a new project. A conceptual estimator recognizes the difference between the value of a bid and the true cost of a project's steel and adjusts the bid amounts accordingly.

When a conceptual estimate for steel is provided to the developer or design-builder, it should only include the value of the work for which the fabricator is taking responsibility. Fabrica-

Typical items to be included in parametric spreadsheet

Project name	Floor-to-floor Height
Customer	Typical Bay Size
Project location	Diaphragm
Project Architect	Expansion Joint?
Engineer of Record	Bracing Type
Construction Start	Tons of Steel
Construction Finish	Steel/square foot
Structure Type	Tons of Joists
Intended Structure Usage	Joists/square foot
Controlling Code	Number of Pieces
Fire Rating	Type of Connections
Type of Fire Protection	Connection: Shop
Special Requirements	Connection: Field
Footprint	Lateral System
Number of Stories	Number of Shear Studs
Total Square Footage	Delivery Method
Roof Area	If bid…our bid
Roof Slope	Winning bidder
Roof Deck	Winning bid
Interior Drains	Value of Steel Packag
Stairs?	Site Access
Penthouse Area	Erect Deck?
Exterior Wall Type	Erect Steel & Joists?
Exterior Wall Area	Value of Erection Package

tors should not provide a conceptual estimate for the whole structure unless they are responsible for it. Instead they should indicate that steel typically represents about 10% of the project cost and invite a design-builder to address the overall cost.

Another way to obtain a feasibility or early conceptual estimate is to use an estimating program, such as CONEDIA or D4COST. Both provide conceptual estimating values based on a database of costs adjusted for time and location factors. CONEDIA works from a design-component methodology and builds a virtual project. CONEDIA presents a series of "what-if" scenarios so the estimator can test various design alternatives. Once the model is created, the estimator can override average unit costs with values that are more representative of local conditions. D4COST approaches the project differently. It looks at projects similar to the proposed project in the database and interpolates between them. The estimator can create a library of proprietary projects in addition to the projects already included and specify certain unit-cost modules for use in the analysis. Although no commercial program will ever replace the need for a company's cost experience, these programs are a good starting point. They provide a reminder of what items should be included in the estimate, a schedule overview in the case of CONEDIA, and a way to check a fabricator's conceptual estimate.

TYPE 2—SCHEMATIC ESTIMATES

As the project is refined, the fabricator can create a schematic or elemental estimate. This estimate is based on a fabricator's trial model of the structure. Once a model is created, a process equivalent to the take-off process of hard-bid estimating follows. The more the prototype conforms to performance specifications, the closer the quantities taken from it will correspond to the actual project. Models can be created easily with in structural design packages. These packages also generate a summary take-off of the components of the structure that can then be "priced."

If the fabricator wants to perform a more detailed take-off and if the software supports a CIS/2 file transfer capability (such as RAM Structural System or ETABS, the design file can be read by a detailing program with CIS/2 capability (SDS2 or Xsteel) and displayed in 3-D. Connections can be designed and detailed take-offs performed. Shop control packages (such as FABTROL) can also importing the CIS/2 file and provide quantity and cost estimates.

It is important to note that the fabricator does not design the structure! The fabricator only creates a model to address structural issues and determine an approximate list of materials from which an estimate can be generated. The fabricator's prototype will have little correspondence to the structural engineer's design. But it is a good estimate of the materials required. Involving the structural engineer of record at this prototype level will integrate preliminary ideas about the actual structure and reduce the uncertainty in the estimate.

TYPE 3—DETAILED ESTIMATE

Finally a detailed estimate is performed once the design documents are developed at least to a 50-percent level. The purpose of this estimate is not to re-negotiate the project, but to provide budgetary control to the fabricating process and to identify areas where contingency funds might need to be applied. If a significant difference exists between the negotiated fee and the detailed estimate, the plans can be reviewed, and cost-saving measures can be applied to the structural system, detailing or erection.

DEFINING THE SCOPE

The definition of the scope of the services provided by the fabricator is a critical element of the conceptual estimate. The following items should be considered in defining the scope of the project:

- Identification of the documents (title and date) that the conceptual estimate is based upon
- Items included in the conceptual estimate (for example: columns, beams, joist, deck, bracing, pour stops, painting, erecting …)
- Items excluded in this conceptual estimate (for example, the structural design. Typically the design-builder will be expecting all items in section 5 of MasterSpec to be included.)
- Design criteria—loads and applicable codes
- Allowable vibration and drift assumptions
- Framing assumptions
- Market conditions and timing that impacts market costs

DEVELOPING CONFIDENCE

The feeling of risk associated with providing a fee for steel on a project without completed drawings is intimidating - but a lack of confidence in the estimate could raise project contingencies. So how does a steel fabricator develop the ability and confidence to provide conceptual estimates?

1. Hire or assign an individual in your firm with the responsibility of conceptual estimating. For many design-builders and specialty contractors this might not be the same staff member that is experienced at hard-bid estimating. The mentality of the hard-bid estimator is one of looking at the details and working up, rather than looking at the scope of the project and working down.
2. Allow your conceptual estimator access to historic project files and to the firm's senior management. The conceptual estimator needs to know historic costs and "rules of thumbs" that have served the firm well. The firm's management must have confidence in the estimates produced, which only results from confidence in the estimator. Communication and trust is essential between a firm's estimator and its management.
3. Develop a spreadsheet with historic bid costs and project parameters. Find old drawings, take-offs and bid sheets. Conceptual estimating is best done with a usable history to draw from.
4. Allow the conceptual estimator time to experiment on past projects. Take a job that was bid two years

How good are they?

Conceptual estimates typically have the following accuracy ranges:

feasibility estimate	+/- 20%
performance estimate	+/- 7%
conceptual design est.	+/- 6%
detailed estimate	+/- 4%

ago, identify two or three parameters and then work through a conceptual estimate for the project using historic data from previous projects. Measure the conceptual estimate against the actual as-built cost for the project, not the bid price, and refine the process on multiple projects.

5. Invest in technology that enhances the conceptual estimating activity. Acquire a commercially available estimating package or consider utilizing one on a per-project basis on the web. Invest in a design package that can export design files using CIS/2 to a detailing or shop management package. Use it on historical projects to develop confidence in the information that it provides and the amount of contingencies that need to be in place for varying design conditions.

6. Develop relationships with local structural engineers that may join your firm's design-build teams. Understand their design approaches, work with them in developing prototype models and discuss the efficiencies of your particular fabricating operation.

7. Pursue design-build work in a familiar market niche with other firms you have trust. You will have more confidence in providing a conceptual estimate in a market you understand. Trustworthy team members provide honest feedback on estimates.

8. Give yourself time to prepare your first few conceptual estimates—if you have to rush your first opportunity, pass it by.

9. Always include a statement of scope with any conceptual estimate.

10. Confirm any conceptual estimate with the most powerful tools you have…your common sense and experience. Ask "does this estimate make sense?"

11. Look at every design-build project as an opportunity to provide the owner with a better project at a lower cost, on a more rapid schedule. Use your experience and your shop's efficiencies to their advantage.

Conceptual estimating is a skill that every design-build team member must have. It is a skill that every fabricator can and must develop—so next time you're at lunch, your clients can benefit by an estimate that brings their ideas off of the back of a napkin and into the realm of possible projects.

William (Bill) Liddy is Senior Advisor in AISC's Steel Solutions Center in Chicago. John Cross, P.E., is National Project Director, Design-Build, with AISC Marketing, LLC, in Chicago.