

# Constructability Reviews: An Opportunity for Partnering

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The partnering concept of working together toward common goals has proven to be highly successful during construction. Constructability reviews offer the opportunity to expand this idea to include the design process. The definition, objectives, and benefits of constructability reviews are examined. The composition of the review team and procedures for conducting a constructability review are also discussed. Case histories of the author's involvement in a number of constructability reviews are related. It is concluded that constructability reviews are the direction of the future, but there is a need for an effective methodology to permit contractor participation in the process.

**C**onstructability is a new word that has been coined to express an idea that is as old as the pyramids and integral to the meaning of engineering: the concept that what has been designed must be capable of being built. The term "constructability" is so new that to date there is no consensus on how to spell the word. Many people use the spelling "constructibility," derived from the spelling of the adjective form "constructible."

Regardless of its spelling, engineers have a clear understanding of what the term means. Constructability review is a form of peer review to determine if the proposed construction can be built as presented in the contract documents. This review includes ascertaining whether the design is feasible, practical, and conducive

to accomplishing the necessary construction operations in a reasonable and efficient manner. Its objective is to determine if the contract work can be completed, as specified, within the contract's time frame and without significant changes. For the owner of a project, the benefits of a constructability review include an independent review of the contract documents, a reduction in the possibility of claims and change orders, additional expertise to suggest economies of construction, and a better product. For the designer, the review serves as a risk management tool. For the construction contractor, an improvement in the quality of the construction documents decreases the possibility of lose-lose delays and therefore increases the profit potential. Because everyone benefits, the process is an ideal candidate for partnering.

## NEW YORK STATE DEPARTMENT OF TRANSPORTATION CRITERIA

Berger, Lehman Associates' experience in performing formal constructability reviews has been primarily for the New York State Department of Transportation (NYSDOT), which has been a leader in using this process. NYSDOT's scope of services for constructability reviews of highway and bridge design requires that biddability and buildability be addressed.

## Biddability

Issues of biddability include the following:

- Is sufficient information contained in the contract documents to allow uninterrupted construction of the project and to avoid major field changes?
- Are the bidders unnecessarily restricted in their bids or has the appropriate degree of flexibility been included in the bidding documents?
- Have the appropriate parties been coordinated during design and have agreements reached with those parties been provided for in the bidding documents (or are such actions in progress)?
- Have all necessary permits been identified and is there enough time to secure those permits before construction?
- Are the maintenance and protection of traffic plans adequate and complete? Are they too restrictive?

## Buildability

Issues of buildability include the following:

- Has sufficient field investigation been made during design so that the project can physically be built?
- Is sufficient right of way available to the contractor for all construction operations and storage required during construction of the project?
- Are the type and sequence of construction activities realistic?
- Can the project be built in the time frame allowed for each individual stage and the amount of time allowed for each construction season?
- Are the materials specified in the contract documents readily available?
- Can the details as shown be constructed using the standard practices of the industry? If unusual contract expertise, special equipment, or nonstandard operations are required, are the performance characteristics and quality of the end product clearly established?

## PROCEDURE

Performing a constructability review requires the formation of a special team that may comprise design experts, contract administrators and resident engineers, specification writers, and claims experts. Ideally, the team should also include a construction contractor. Few design professionals or resident construction engineers can provide better insight than someone whose success or failure depends on his or her ability to understand and implement the contract documents. Unfortunately,

because such participation would preclude the contractor from bidding on the project because of a perceived information advantage, it is difficult to obtain such assistance.

Constructability reviews are a form of peer review. Reviews often require questioning the fundamental premises of a project or owner's standard procedure; therefore, they are most successfully conducted by an outside consultant. They can, however, be conducted by the owner's engineering staff or the designer.

For a constructability review, or any other review, to be effective, it must be performed in a timely manner so that changes, if necessary, can still be incorporated in the contract documents. This generally means that the review must be conducted at the advance detail plan submission stage (approximately 80 percent completion), when the documents are expected to be essentially complete but may not yet be checked.

This can be an inopportune time for the designer because internal quality control procedures and checking may still be occurring and certain details may still be in development. The designer naturally will feel vulnerable to unjust criticism, particularly by an outside reviewer in front of the designer's client. Therefore, it is incumbent on the review team to conduct the review in a professional, nonconfrontational manner and to make constructive criticisms. In a real sense, the constructability reviewers must engage in "partnering" with the owner and the designer.

The constructability review ideally begins with the designers briefing the constructability review team on the project. Then the reviewers must become thoroughly familiar with the project scope, project site, and review documents. Next, each member of the review team formulates comments based on his or her area of expertise. Group discussion and brainstorming of initial comments serve to synthesize the individual comments into an overall picture. Finally, the review team project manager edits these comments to create a comprehensive report that is presented to the client and the designer at a joint meeting.

Frequently, constructability review comments relate to items that result from policies or directions given by the owner or client. This should not stop the reviewers from questioning them. The owner is entitled to this insight, even if other considerations may preclude implementation of the suggestions. The owner, in turn, must be willing to take a second look at prior decisions and policies to determine if they meet present needs.

The decision of whether to implement particular constructability review comments must ultimately be made by the owner, subject only to the limitation of the designer's professional responsibility. The constructability reviewers must recognize this hierarchy, as well as the fact that the design must be guided by the comments

and requirements of other agencies. Although contradictory opinions may develop, honest resolution of these issues through an open, professional discussion will result in a better design. Again, this is most successfully accomplished in a partnering atmosphere, wherein each party acknowledges the common goal.

## CASE HISTORIES

### Oak Point Link Rail Connection

The Oak Point project required the completion of a 1.8-m-long railroad trestle along the shoreline of the Harlem River in the South Bronx, New York, between the south end of the Highbridge Yard and the west end of the Harlem River Yard. A previous construction contract had been terminated because of problems with the caisson foundations.

Berger, Lehman Associates, the designer for the completion contract, was also charged with conducting an unbiased constructability review. The impartiality of the review team was maintained by making a senior officer of the firm, who was not involved in the design, responsible for the review. The unique feature of the panel was the inclusion of the president of a preeminent marine construction contractor. His firm had to waive its right to bid on the project in order to participate. The team also included an independent marine construction consultant and a geologist.

By working with the design team and the client, NYSDOT, the panel was instrumental in developing more progressive and equitable payment items to compensate the construction contractor for unknown foundation conditions. Contractor representatives on the panel and the NYSDOT's specification writers had many lively discussions on this subject. Through these discussions, each party learned from the other, and together they reduced a new, equitable payment system. Previously, a single payment item was provided for length of caisson installed, which would have forced the contractor to assume all risk for unknown subsurface conditions. The new specifications provided separate payment for ordered length of pipe shell, driven length, and removal obstructions. Another major recommendation of the review was to conduct a pile driving and load testing program, in advance of construction, to verify the driving criteria for the redesigned caissons without rock sockets. The full-time, on-site presence of a geotechnical design engineer during construction to facilitate real-time decisions about foundation conditions was also recommended. These recommendations were implemented, and construction operations to date have proven their value.

### Mineola Grade Crossing Elimination

The Mineola project provides for the elimination of the grade crossing of the Long Island Rail Road main line at Herricks Road in Mineola, Long Island. It involves raising the Long Island Rail Road's two-track line for a length of  $5,000 \pm$  ft. Herricks Road, a four-lane roadway, is an important north-south connector in Nassau County. It will be depressed approximately 7 ft at the railroad intersection to provide a roadway clearance of 14 ft 6 in.

The project involves the construction of new east-bound and westbound mainline tracks and a third track within the northern portion of the existing right of way. This requires the temporary relocation of the two main line tracks southward within the railroad right of way and the use of temporary easements.

Berger, Lehman Associates undertook an independent constructability review of this project for NYSDOT that was based on the advance detail plan submission prepared by others. The primary recommendation was to retain a construction manager or coordinator to ensure that the design and construction of railroad work, utility work, roadway work, easements, acquisitions, and long-term procurement of materials would be accomplished in a timely and coordinated manner. A construction agreement between all parties would be required to facilitate coordination and empower the construction manager. Further, to accomplish the necessary coordination, all parties would address and accept a critical path method schedule embracing all critical elements.

### Bruckner Expressway

Two contracts for the Bruckner Expressway project provide for deck, parapet, superstructure, and substructure rehabilitation of a 2-mi viaduct carrying the Bruckner Expressway (I-278) in the Bronx.

The Bruckner Expressway, which carries six lanes of traffic, links the Triborough Bridge/Major Deegan Expressway (I-87) and points west and south to the Sheridan Expressway (I-895), the New England Thruway/Cross Bronx Expressway (I-95), and points north and east. In the project area, the Bruckner Expressway is on a viaduct. Bruckner Boulevard, a nine-lane urban arterial, runs underneath and parallel to the viaduct.

Traffic requirements dictate the performance of construction in stages. The intent of this staging is to provide a minimum of two traffic lanes in each direction at all times. Up to half of the traffic that normally uses the viaduct will be detoured onto Bruckner Boulevard during construction.

Berger, Lehman performed an independent constructability review for NYSDOT. The contract documents were found to present a clear picture of the work to be performed and were considered to be biddable and constructible. The following is a sampling of the recommendations made:

1. The proposed starting date for construction should be coordinated with an adjacent construction contract that is behind schedule and will not be completed in time.
2. Shielding is required for pedestrian undercrossings, including a pedestrian bridge used by schoolchildren.
3. Incident management procedures need to be included in the contract to clear stalled vehicles in areas of single lane operation.
4. Incentive and disincentive provisions should be incorporated for work on critical ramps, particularly where it is otherwise advantageous to the contractor to not reopen the ramp because doing so would increase traffic problems.
5. Coordination with the city of New York is required to retime signals on the detour routes.
6. The construction schedule does not provide for winter shutdowns.
7. Maintenance and protection of traffic schemes are needed for bearings replacements, which require falsework in the streets below the viaduct.
8. A full-time traffic coordinator should be provided.
9. The plans should be updated to indicate protective shielding placed by others since the designer's field investigation.
10. The tops of lampposts beneath the viaduct will interfere with specified shielding between the bottom of girder flanges.
11. Traffic signal heads and conduits mounted on some of the concrete piers must be relocated to permit required concrete repairs.
12. A number of specifications need to be coordinated with the drawings so information "as shown on the plans" is provided.

## Other Projects

On a highly complex truss rehabilitation project, the constructability review recommended that the owner enter a formal partnering agreement with the contractor, the designer be engaged to provide construction support services, and the precision steelwork involved in strengthening the truss members be declared a specialty item. All these recommendations were departures from previous policies of the owner. It was also recommended that the contractors be allowed extra time to prepare their bids because of complexity of the project. The anticipated construction schedule was found to require reevaluation because of unrealistic required contractor staffing levels and potential conflicts with sporting events.

## SUMMARY

The concept of working together toward common goals has proven to be successful during construction. Constructability reviews enable this idea to be expanded to include the design process. Doing so requires a professional, constructive attitude from the review team; a positive, cooperative approach by the designer; and flexibility on the part of the owner. Hopefully, when an equitable methodology is found, contractor participation will be a routine part of constructability reviews.

Just as partnering has gained widespread acceptance, constructability reviews may be the direction of the future for complex projects. Designers, owners, contractors, and the public will all benefit.

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