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CONSTRUCTIBILITY REVIEWS: CASE STUDY OF BID DOCUMENT ERRORS AND OMISSIONS

BY: KEN PRUETT, PROJECT MANAGER, PINNACLEONE

The specific objective of a Constructibility Review should be to minimize or eliminate potential change orders and delay claims during construction by ensuring that the Construction Documents are fully coordinated, complete, and buildable. While accomplishing that primary objective, a constructibility review should also seek to eliminate the redundancy in quality control reviews being performed by different entities involved in the project such as architects, peer reviewers, and permitting agencies.

Formal constructibility review programs have been conducted on enormous public works programs such as the Los Angeles County USC Medical Center and the Los Angeles Unified School District's school bond program as well as many other programs across the nation. For a large public works program with construction cost of over $500 million, a 2 to 5% reduction in construction costs through a comprehensive constructibility review can result in millions of dollars in savings for what are relatively minor costs associated with conducting the reviews. Any project whether small or large stands to benefit by a properly conducted constructibility review by reducing the occurrence and extent of change orders, claims, schedule delays, or simply by preserving a better relationship between owner, construction manager, contractor, and architect. This article describes some particular recurring construction document errors and omissions or trends that were encountered on projects that instituted a formal review process.

The Los Angeles Unified School District (LAUSD) embarked on a program in 2000 to construct over 150 new schools with a combined hard construction cost of $1.5 billion through a voter-approved bond proposition. The program was completing its design phase and transitioning into the plan check/permit phase. The District recognized the need to conduct constructibility reviews at the conclusion of the design phase mitigate contract change exposure. The Contract Documents were being produced with subjective and arbitrary notes such as…

- "The Architect assumes *no responsibility* for the completeness of the plans for bid purposes…"
- "Provide trap and vent *as required*. Provide condensate pumps *if necessary*"
- "Contractor to provide fire and smoke dampers *as needed* at all rated wall penetrations"
- "If phased construction is required by the District, the District will allow a *30-day time extension* for the contract"

A unique constructibility Program was adopted by the LAUSD to address the potential contract change order exposure. Constructibility management tools were developed and utilized on the LAUSD program including comprehensive constructibility checklists, dedicated in-house review teams, constructibility audits as construction was on-going or complete, and a detailed scope of work for all review participants. A constructibility team was mobilized and over the span of a year was successful in reviewing all of the design packages prior to submission to the permitting agency. The team discovered literally thousands of errors, omissions, conflicts and ambiguities in the contract documents which were noted and, as verified by a back-check system, incorporated into the contract documents. It is estimated that the as a result of catching the problems prior to contracting, that the District received at least a 10 to 1 pay back on the cost of the constructibility review team. This paper discusses some of the lessons learned from that program and makes several recommendations that can easily be adopted to future public works construction programs.

Constructibility Defined

Again, the specific objective of a constructibility review program is to minimize the occurrence and scope of potential change orders and schedule delays during construction by ensuring that *ALL* the construction documents are fully coordinated, complete, and *buildable*.

When saying *ALL* Construction Documents, it is indicating that the scope of the review cannot be limited to a review of the Contract Documents provided by the architect. Traditionally, owners provide integral portions of the Contract Documents such as survey, as-built, geotechnical, hazardous material, environmental, and other pre-construction documentation. Often times constructibility reviews are conducted on behalf of an owner and erroneously exclude the "owner-furnished" bid package elements. All elements that make up the contract documents need to be concurrently reviewed - drawings, as-built conditions, specifications, geotechnical reports, environmental documents, site topographic and utility surveys, etc.

We use the term *buildable* to help define and limit the scope of the constructibility review to a review of those elements which make a design buildable. This is important in order to eliminate the document review redundancies that can occur. In the case of the LAUSD projects, the jurisdictional review agency, Division of the State Architect, looks for code-related errors and omissions in the construction documents and would often outsource the reviews to design engineering firms. Or an owner may conduct independent "peer" reviews by engineering or architectural firms to validate design and engineering assumptions.

We were careful to focus our efforts not on the code or engineering aspects of the documents, but the portions of the documents that really make it buildable for a contractors and subcontractors. Typical questions while conducting the review include:

- Are there a sufficient number of wall sections/elevations,
- Are there a sufficient number of details,

- Is sufficient information provided in the sections/elevations/ details,
- Are the plans, sections, elevations, and details coordinated between architectural, structural, civil/site, and MEP drawings?

These questions are indicative of the type of questions that should be asked and answered when validating whether documents are buildable.

Constructibility Review Methodology

The methodology or approach to conducting a constructibility review should be consistent with the goals of the review. As stated above, the focus should be to concurrently review all documents and focus on their buildability. The right personnel and tools are necessary to effectively execute the review. The approach adopted for the LAUSD program was to establish multi-disciplinary review teams with construction-experienced personnel, create and provide the reviewers with comprehensive constructibility management tools, conduct constructibility audits on projects under construction or completed to ascertain and prevent recurring bid document errors, and conduct site visits to verify site topographic, utility, easement, surrounding public utility, and other existing conditions.

Multi-Disciplinary Reviews: The success of a constructibility review lies in the quality of the personnel assigned to participate in the constructibility review. Individuals with direct *construction field* experience should be selected to perform constructibility reviews. The initial Program, Design, and Peer reviews are typically done by architects and engineers and are viewed from a "designer's" perspective while the constructibility review team views the documents through a "builder" perspecitve. Wouldn't it be great to get the grouchy old field superintendent who declares on every project…"this is the worst set of drawings I've ever seen!", to review and comment on the documents during the design phase? It may be difficult to corral that individual from the field and have them sit down in an office to conduct a constructibility review but those types of people who have to deal with the end result of bid document errors and omissions and lack of coordination are perfect candidates for review team members.

Constructibility Management Tools: The review team needs to have management tools that act as a guide to finding missing or uncoordinated contract document information, including a detailed constructibility scope of work. The LAUSD program was unique because of the large number of projects that were under construction or in design at any one time. It afforded us the opportunity to examine where previous bid document errors and omissions occurred and then apply that knowledge to the review of projects that were currently in design. We were able to continually build upon a "lesson learned" database of specific problem areas. The detailed constructibility scope of work defined areas to be reviewed in the documents and assigned multi-disciplinary team members responsible for there completion. In practice, each reviewer was responsible for catching comments such as …"see structural"…or …"provided by others"… and then verifying that the design does in fact address the comment in the "structural" documents or that some other discipline, owner-furnished product, or utility agency is the "by others".

Constructibility Audits: The purpose of a "constructibility audit" is to identify typical or frequently repeating errors or omissions that have resulted in changes orders on completed or under construction projects. The audit should be the genesis of any lessons learned database which is ultimately used to prevent design mistakes from continuing to occur on future projects. At LAUSD it became apparent after conducting only a limited number of constructibility audits that there were obvious trends in the errors and omissions in the contract documents. Lack of information about existing site conditions, coordination of MEP systems within the useable plenum space, and weaknesses between the coordination of civil, utility and site plumbing information were some of the trends revealed. These lessons learned were added to the constructibility checklists established at the beginning of the constructibility program. Interviews with site personnel – superintendents, inspectors, and contractors also helped to formulate the lessons learned database. All this information was fed back to the reviewers conducting the constructibility reviews so that there was a continual improvement in the quality and thoroughness of the reviews.

Site Visits: Site visits are an integral part of the review whether it is a remodel, addition, or new construction. Many projects start off wrong simply because no one has checked the site information which is customarily derived early in the project phase and by the owner. The individual on the review team that is reviewing the civil portion of the bid documents is likely the most appropriate person to visit the site on a new construction project. For the LAUSD program, the civil reviewer visited the site with topographic and utility survey and all site plan (architectural, plumbing, electrical) information in hand. The civil reviewer would verify that the conditions existing on site were as depicted on the documents. The architectural, structural, MEP, and civil reviewers all may need to visit the site as a part of their reviews for additions projects. The site visit ended up being one of the most revealing and beneficial aspects of the LAUSD constructibility review program.

Constructibility Review Results (Lessons Learned)

"Performance" Type of Drawings/Specifications: Most of the designs relied on "performance" type of drawings and specifications to represent certain systems. Precast panels and precast support systems, fire sprinkler systems, and shoring systems were examples of where a designer may specify these systems in a performance manner and place the design-build responsibility on the contractor. Although this seems to be standard practice within the design industry, gaps in the scope of work occur if they are not properly specified. For instance, if no fire sprinkler systems drawings are included or at best a schematic of a fire sprinkler riser line is provided, then it is likely that the bid documents fail to address the installation of power or signal to the fire sprinkler flow switches since the switched would not be shown on the drawings.

Coordination with Geotechnical Recommendations: Blanket statements about compliance with recommendations made in the referenced geotechnical reports in the structural general notes where often found to be in conflict with the information provided in the earthwork specifications or structural drawings. The geotechnical reports would often address several options or flatly made no reference to conditions

shown on the drawings (i.e. – allowable shoring systems). The result was a potential conflict between the geotechnical, earthwork, or structural systems which were unclear at the time of bid or were subjective and left the least expensive, and often less desirable, option to the contractor.

Subjective Notes: If you want to get an earful, ask that grouchy old field superintendent how he feels about drawings riddled with subjective phrases such as …"in an approved manner" or …"as needed". Field supervisors and inspectors struggle with the final acceptance of components shown to be installed "in an approved manner". Referencing specific WIC or other industry standards can often mitigate disputes that arise from these subjective comments.

Unaddressed Site Conditions: Again, maybe the most important part of the constructibility review. Site conditions can change dramatically from the time a project owner conducts a site survey or an architect initially visits the site to the time of bid. The documents reviewed on the LAUSD program consistently did a very poor job of illustrating the complete picture on site. Projects that involved additions or modifications to existing facilities suffer in particular from unaddressed site conditions. Close attention needs to be paid to new construction integrating with existing construction. If new raceways are shown indicated intruding into existing areas, hazardous material mitigation, plenum space conflicts, or available panelboard space for new circuits need to be addressed. Numerous times when new electrical or systems panelboards were to be added to existing electrical, mechanical, or LAN rooms, the rooms lacked the physical space to install the new panels. This portion of the review can not be stressed enough.

Other Issues: Other common errors and omissions consistently discovered in the audits or the reviews were failure to provide enough useable plenum space. Project budget concerns resulted in reduced floor to floor heights while at the same time aesthetic design considerations increase ceiling heights. These two factors limit plenum space with the inevitable impact to ductwork, cable trays, and ceiling-mounted equipment. Horizontal control (civil) information needs to provide benchmarks and centerlines and have sufficient dimensional information to locate all major building and site features outside of easements and right-of-ways. Site plans also need to consider adequate offsets to adjacent properties to prevent undermining of neighboring properties. Electrical documents need to consider all miscellaneous power requirements – carbon monoxide sensors, high water level alarms, irrigation controllers, automatic overhead doors, and miscellaneous mechanical equipment. Owner-furnished kitchen or medical equipment needs to clearly define where the owner's "furnishing" scope stops and the contractor's "installation" scope begins.

Summary

The constructibility review should never target only the bid documents provided by the designer. Although the bulk of the documents bid will be produced by the architect/engineer, the effect of owner-furnished, utility agency, or environmental documentation needs to be concurrently reviewed.

The most qualified constructibility reviewers are those individuals that have dealt with the by-product of bid document errors and omissions in the field. Superintendents, inspectors, or managers who have been involved in resolving unclear construction conditions or settling change orders and claims have an excellent background that can be applied in the up front constructibility reviews. Their knowledge combined with some form of a constructibility checklist that is derived from audits of previous projects and changes are necessary for a comprehensive and successful constructibility review.

The checking or "backchecking" for incorporation of the constructibility comments by the designer has not been mentioned but is a natural activity to follow the constructibility review. Several meetings with the architect/engineer subsequent to the review may be necessary to resolve all of the comments. Consensus on whether to incorporate or not apply each constructibility comment should be reached by the project team.

The timing of the review needs to be considered as well. A review should occur when enough detailed information is available to conduct a constructibility review. The 50% construction document stage and after the submittal of the 100% construction documents to the jurisdictional review agency are good milestone dates to conduct reviews. Not as much information is available at the 50% construction document stage so the review should be pared to match the level of information provided.

The constructibility review, when conducted properly and focused on those issues that affect buildability, will pay for itself. It can be difficult to quantify in dollars what the review has saved an owner since the stage of construction that the error is discovered has the biggest impact on its cost. However, you need only uncover a few of the major and recurring issues listed above to realize its value.