

As-builts – Problems & Proposed Solutions

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Abstract

Most, if not all, construction contracts require the contractor to produce as-built drawings. However, little information is found in industry literature about construction as-builts and the as-building process. How are they properly executed and to what standards? Who is responsible for the content? How will they be used? The answers to these questions may not be obvious. The construction management (CM) industry should attack the subject in detail. This paper begins the attack by discussing some of the inherent problems in obtaining quality work. It offers some solutions, including the need to develop standards and sharing part of the contractor's responsibilities in providing them. Specifically, this paper presents three proposals. First, it makes a case for the CM industry to develop general as-built standards that could be used for most construction contracts. Second, it offers a payment vehicle to the contractor for producing them. Finally, it proposes that the construction manager take an active role in the as-building process.

Introduction

Over the course of any construction project, the work scope changes. Change is a normal and expected part of the construction process. Changes can be the result of necessary design modifications, differing site conditions, material availability, contractor-requested changes, value engineering and impacts from third parties, to name a few. Beyond executing the change in the field, the change normally needs to be documented to show what was actually constructed. Hence, the owner usually requires a final record to show all changes or, more specifically, any change that modifies the tangible portions of the finished work. The record is made on the contract documents – usually, but not necessarily limited to, the design drawings. The end product of this effort is what the industry terms as-built¹ drawings, or more simply, “as-builts.” The requirement for providing them is a norm in construction contracts.

As-builts (AB) are an important part of a contractor's work scope. Unfortunately, they are often overlooked by both the CM and contractor until the end of the project, when they are needed. They are important for those who use the finished product, as they provide a legacy of what was actually built. This legacy becomes more important, as we continue to build on top of old work, land ownership changes, or for public works, as employees familiar with what was built are replaced over time by attrition. ABs are overlooked during construction because there are too many other activities occurring during the building process and, simply put, documenting changes is not a glamorous

¹ Merriam-Webster has tracked citations of the word as an adjective only, but has not considered inclusion into the dictionary because they consider it an industry term. The term does exist in construction dictionaries. The term always appears hyphenated and its usage can be as a verb, noun or adjective.

part of the project. Certainly project schedule reviews, pay request deadlines and claims resolution appear to be worthier of a CM's attention. ABs are sometimes treated as an administrative obstacle, among many others, needed to close out the project. They are generally the last submittal to be processed. Grappling with them usually languishes beyond substantial completion. It is indeed unfortunate that a CM who does an excellent job for an impressed client can fail at the job of assuring an acceptable as-constructed record. It does not need to be this way.

Construction ABs are not to be confused with other types of as-constructed documents. Other as-constructed documents include Record Drawings (RD), AB schedules, ABs created by redrafting old drawings that depict existing work and AB surveys. The latter is where an existing structure or work site is surveyed to produce drawings from scratch. In this process, technicians take field measurements of building floor plans, site improvements or topography, then electronically draft the information to CAD standards. Construction ABs discussed here are contract documents revised during construction and submitted by the contractor for review and approval by the CM either monthly or after final completion of newly constructed work².

Before considering some changes to the way ABs are done, one should first define exactly what purposes they serve and explain some of the problems associated with them.

Purpose

Construction ABs are used to show the finished condition of the work as it was actually constructed and accepted. The as-builting task is a usual and important requirement of construction contracts and contract language puts this work upon the contractor. The process requires that any change that modifies the original design be incorporated by drafting the change upon one set of contract documents earmarked just for that purpose. Generally, changes are recognized or authorized within contract-related documents that are prepared during the course of work. Change documentation may include incorporation of a contractor's Notices of Change that are acknowledged as having merit by the CM, change orders, field orders and non-conforming work that was accepted "as-is" or mitigated by other means. It would also include value engineering agreements, certain T&M authorizations and, sometimes, responses to RFIs. Documentation may also include the incorporation of addenda that were issued during the bid cycle, when conformed drawings were not issued by the owner. To be complete, ABs would also require that the contractor record a change for which no authorizing document exists. Obviously, that is more theoretical than actually practiced, as no contractor would necessarily want to show a change he was not allowed to make in the first place – especially as he might be penalized for it. ABs serve four important roles. Each role is discussed in the order of its use.

² Various definitions exist. BNi Building News Construction Dictionary defines the word better than most, as "A set of drawings prepared by the general contractor, which include any revision in the working drawings and specification during construction, indicating how the project was actually constructed."

The first role of ABs is to serve as a one-stop repository of all directed changes. Hence, the general contractor and all his subcontractors are, theoretically at least, working from the same up-to-date documents as the work progresses. This assumes that the documents are updated as soon as information becomes available. In this case, the role of AB drawings is an information resource available during the course of work that depicts all current, authorized changes. The contractor is expected to update the AB records as the work progresses and to do so in a timely fashion in order to make them useable for all construction parties, including the inspector. In this sense, ABs are not only a record of what was done, but also a plan of what the contractor was directed to do. The logic is that no required work will be missed.

The second role is, post construction, as a contractor's certified record attesting to what was built. Thereafter the drawings can be used by the owner or operator as a reference over the working life of the improvement. This enables the user to locate hidden features and troubleshoot problems, and provides a tool to plan for changes or expansion. The owner may have secondary uses for them, such as safety training, failure analysis, inclusion in various manuals, tenant information, lease/sales literature and information required by regulators. If a facility is sold, ABs usually are listed in the sales agreement as "other property" transferred to the buyer. The owner can also use them as documents upon which to record subsequent minor modifications made by or for the owner. With all these ongoing uses, the owner considers AB drawings to be a living document.

For their third role, ABs eventually become demolition drawings when improvements are no longer needed. They can be modified, repackaged, reproduced and included in a new contract, saving the owner the cost of developing new drawings. As demolition drawings, ABs will have been used over the complete life cycle of the facility. The repackaged demolition drawings can then be AB yet again to record what was *not* demolished, and those drawings live as part of the next contract.

The fourth and last role of ABs is for land-use history. ABs serve as a record of what was. The information they provide can pay dividends during subsequent land uses. For example, during construction, if an unforeseen object is encountered, AB research might show that the object could be a structure left over from three previous land uses that erroneously was thought to have been removed. Another example would be to provide land-use history needed in a Phase I environmental audit. AB drawings usually outlive the submittal files and other job records, including sometimes the construction contract itself. ABs become the last testament to what once existed.

ABs have hidden benefits for both parties of a construction contract. If changes are properly drafted and referenced to the document that initiated the change, ABs can allow for checks and balances against work not billed or deletions not credited. For an example benefiting the owner, consider a case in which the engineer deletes part of the work, but based upon the way the contractor documents it, the CM finds that the deletion was interpreted differently. The contractor assumed the change to be more far-reaching than allowed. In this case, the contractor did much less work than what payment was agreed for. The CM may want to revisit the agreed-upon credit. An example benefiting the contractor, say the contractor incorporated a change that was

to be paid as T&M, but shows no referenced T&M billing authorization on his drawings. He would want to double-check the paper trail to make sure the owner was billed for the work. Specifically for the benefit of the CM, ABs may reveal non-conforming work, thus prompting an investigation and even some rework. It is entirely possible for ABs to be used in claims and litigation by either party or even a third party (the latter is not an intended purpose).

Problems

Some contractors do an excellent job of providing quality as-constructed records. These contractors are the minority. The remainder do fair to mediocre work at best – their work is sloppy, incomplete, or illegible, with documents stapled to drawings and other related shortcomings. A few contractors have been known to submit contract drawings as ABs without a making any notations on them. When contractors do not provide an acceptable set of documents, one must ask why. The causes are varied, but most reasons can be attributed to either a lack of motivation, not fully understanding what is ultimately expected of them, or both. There are two lesser causes behind unacceptable ABs. One is that a general contractor who can not coordinate all the parties responsible for providing their portions of the AB record. The other is the perception of not being paid for the effort. Let us look into each.

Lack of Motivation

Some contractors are unwilling to do quality AB work or even incapable of it, as they are not motivated to do the work that is required. This can be due to a variety of reasons – lack of staff, time, budget, commitment, or simply not valuing the need despite the contract requirement to provide them. If done, the as-building task usually falls upon the least experienced engineer, summer intern or lowest ranking staff member. These are people who are usually too “green” to understand the contracting process, contract divisions, materials and all construction-speak – individuals who are lowest on the pay scale. These individuals may receive no instructions other than, “Here’s the specifications and drawings” and “Just do it.” Unfortunately, the same can be said for the owner’s representative responsible for reviewing them, further justifying the contractor’s perception that ABs are not valued. Worded differently, the perception is that if the owner provides a mediocre review, then the owner is not very concerned about them. Both the contractor and CM can be guilty of lacking motivation, and if one or both are, the process suffers and the result proves it.

There is little motivation on the part of the contractor to transpose line work that is clearly shown in responses to RFIs, change orders or other documents that he widely distributes to his superintendents, foremen, subcontractors, manufacturers and suppliers. His perception is that there is no need to maintain a drawing set that nobody uses because these other documents provide all the information that is needed. Transposing information appears redundant to the contractor. Furthermore, in the case of an unauthorized change, there is no good reason for the contractor to document a deviation for which he might be penalized. The contractor would not want to show that a hose bib installation on the north wall was missed, and risk having to dig up pavement to put one in.

Other clues pointing to contractors' lack of motivation are revealed by statements they make. We have all heard the contractor's argument that ABs are not required because *"We built it exactly the way it is shown!"* That statement is often used in an attempt to end further discussion and get the CM to forego the requirement. The CM and his inspectors know otherwise; in fact, it was not built exactly the way it was designed. Another argument might be, *"I showed it in one spot and that's good enough!"* This attitude can affect multiple drawings, such as the case in which a structural change is shown properly on the structural drawings but not carried over onto the mechanical drawings where it is also needed. *"How do you expect us to record everything with all the changes you made?"* This question and similar statements are made to get the CM "off the back" of a contractor. From that point forward, it may simply be a test of wills to get marks on the drawings. One last contractor's argument: *"Our as-builts have never been questioned before!"* In other words, no matter how bad they are, the CM is being too picky.

Time will eventually cure the motivation problem. As the job comes to a close and retention is demanded, some level of ABs are submitted if for no other reason than to close-out the job and move on.

No Payment

It costs a contractor staff time to collect and analyze information, produce marked-up drawings and participate in the monthly review. He receives no direct reimbursement for his time and effort, as the task is considered ancillary to the work and therefore must be absorbed by his project overhead. As there is no contract allowance or bid item, there is no financial incentive to put forth a great effort. Less effort is more profit. The requirement is disregarded as boilerplate contract language that seems to apply to other contractors on other jobs. The only way the CM can ensure ABs are being properly kept and updated is to periodically review the contractor's markups and, if necessary, withhold a progress payment. Withholding a full monthly progress payment is not done. Why? As a punitive measure, it is not realistic or commensurate with the damage done. Most owners would be reluctant to follow the advice of a CM to hold a payment because as-constructed records are incomplete. Instead, the client would tell the CM to make sure they are corrected by the following month and then ask how the CM is going to make sure that next time they are up to par. CMs likewise can be reluctant to make the contractor "toe the line" as surely the needed corrections can be postponed until next month. Certainly there are more pressing issues overshadowing the status of ABs and the CM has to continue "to get along" with the contractor for the good of the project. When enforcement is pushed off for one month, that one month turns in to two, then three, until reaching the end of the job – too late to do an adequate and accurate job of documenting all changes.

Brokered Work

It is not unusual that a general contractor performs less than fifty percent of the work with his own forces. He needs to broker the rest. Brokering the work scope has been by necessity. Why? Construction work scopes can require many specialized activities for

which a general contractor needs to rely on specialty subcontractors and of many tiers. Consider the evolving security system technologies, expertise needed in geotechnical foundation work, code-driven fire protection installations, and the specialty coating and concrete repair fields. Consider the number of specification divisions in a \$5 million contract and the number of specialties required to meet them. Delving deeper, some work is paid not under a subcontract, but under a purchase order (e.g., precast plant work, owner-operated equipment and electrical testing by certified companies). Purchase orders are used not just to supply materials, but to perform contract work on or off the site. An example would be assembling an electrical switchgear. It is clear many parties are responsible to perform the work and consequently responsible to supply AB information for their portions of the work. The general contractor must coordinate a massive amount of as-constructed information – a daunting task.

Specialty subcontracting and off-site fabrication conflicts with the assumption that the general contractor and the rest of his team are working from the same master documents held by the general contractor as the work progresses. It just does not happen. There may be too many subcontracting organizations involved and, although each may be working on the same site, they are working from different site offices. A few may be working from pick-up trucks. Subcontractor site offices can be adjacent to the general contractor or on opposite sides of the site; it doesn't matter as each, by necessity, keeps its own sets of contract documents. It is unrealistic and naive to believe other parties go the general for the latest information on his drawing stick files. Compounding the impacts of working from different site offices, subcontractors undertake their portions of the work at different times over the course of the project. The electrical subcontractor, as an example, might be the last to arrive and may be unaware that the equipment foundations they need to work from were moved. For these logistical reasons, subcontractors work independently. One would hope that subcontractors are made aware of changes when they begin work and that they transfer those changes to their own master drawing sets. This requires the general contractor to collect and combine information from all subcontractors and off-site fabricators for inclusion in his ABs.

Expectations

For AB work, the only written direction a contractor has as to what is required of him is that which is provided in the contract specifications – *if* there are specifications. AB specifications tend to be short, sometimes one or two paragraphs. This is hardly a comprehensive recipe for what to do and how to do it. Even specifications that consist of an entire technical division can not possibly be expected to cover the documentation needs of every changed condition.

ABs can, and usually do, have different meanings to different stakeholders. Each party to a contract and the individuals within each party have their own ideas about what should be recorded and how. Each party has different ideas as to clarity and completeness. Each party has different perceptions about timeliness for entries and presentation. This is a result of different assumptions and experiences. With differences in expectations, misunderstandings often surface. Disagreements can occur between the CM and contractor as to what constitutes a change and, if it is agreed that a

change was made, whether that change should be documented and what form that change should take. For example, the owner may want to know exactly where each buried utility lies, but the design drawings are schematics and therefore the contractor excuses himself from providing useful dimensions, survey coordinates and top-of-pipe elevations. Another example is where the engineer wants the contractor to show rebar hooks in a wall that were later added to meet code. The contractor argues they will never be seen and refuses to make the proper notations. The last example is the CM who wants each individual contract drawing to show the complete AB condition. However, the contractor provides three separate marked-up sheets of the same drawing because even though structural, electrical and instrumentation are shown on the same sheet, they are AB by different subcontractors. One sheet is provided by the general contractor to show structural changes, one by the electrical and one by the instrumentation subcontractors. Different expectations usually ends with the CM or owner being dissatisfied with what is delivered versus what he envisioned receiving.

Lack of motivation, the perception of not being reimbursed, the fact that too many contracting parties are responsible for providing AB information and differing expectations are reasons why ABs rarely meet the mark. The remainder of this paper addresses some new approaches to combat these problems.

A Standard

The preceding problems are common and familiar to construction managers. They span all project delivery methods and all types of projects. To help rectify two of the problems, those of differing expectations and brokered work, the CM industry needs an AB standard. AB guidelines of various complexities do exist for some government entities, but not for the construction industry as a whole. Generally, what is known about as-building in most organizations is what is learned by word of mouth, example and by trial and error. A properly written standard can be the basis for education, a standardization of methods and minimum acceptable results, and an aid to contract enforcement. Otherwise, each job will continue to be based only on the typically brief project specification and the CM will continue to struggle with contractors over ABs. The industry is overdue for a standard. The CMAA, as a national leader, may be in the best position to take the lead in developing an AB standard. The following lists topics that could be included and issues that should be addressed in an industry standard:

- General considerations – Explain the need for, and objectives and benefits of, construction ABs. Explain their expected form. Explain their uses as living documents and final records. Suggest what types of contracts should be exempt from AB requirements. The standard should address needed discussions with the client and engineer during the design phase to ascertain what their requirements are in an as-constructed record. Does private work require different AB standards than public work? Discuss the need to keep the record current as memories fade and personnel change over the duration of the job.

- Case law – Explain how courts and arbiters have ruled. Present important legal decisions relating to ABs and apply lessons learned³.
- Discuss what designers need to know to facilitate the AB process. Some examples include:
 - ✓ Drawing sheets should not be crowded. Drawings loaded with notes and linework do not allow room to make changes.
 - ✓ Conformed drawings should be issued where extensive changes are made by addendum.
 - ✓ The owner/engineer is obligated to reissue drawings that have undergone numerous design changes during the course of work.
 - ✓ Schematic designs should not be provided if accurate ABs are desired. It is difficult to change a detail that was Not-To-Scale in the first place.
- Address the CM's obligation to discuss the AB requirement and its importance at pre-bid, partnering and preconstruction meetings.
- Provide a clear definition of what constitutes an AB condition versus what does not⁴. Provide test cases or examples and explain why one change is considered documentable versus another that is not.
- Provide direction as to which contract documents should be used to record AB information. These may be (full-sized) plans, specifications and, depending on the type of contract and the needs of the owner, fabrication drawings, concrete lift drawings, pipe spool drawings and contractor-provided designs. Address whether the surveyor's electronic files and his certified survey are part of the effort, thereby superceding coordinate tables and utility profiles shown on contract drawings. Explain what contract documents may be exempt from the process and why. Examples may include above-grade demolition drawings, formwork drawings showing embedded hardware, appendices, standard plans included in the contract set, drawings incorporated by reference and electrical one-lines, if corrected in the O&M manual.
- List all documents that could be the sources for AB information. Address how they are collected. Address whether directives provided in meeting notes or unofficial documentation can be used and incorporated. List documents that are to be

³ For example, *Toombs v. United States*, 4Cl.Ct535(1984), which required the government be reimbursed for doing the as-built work the contractor did not do. Also, *McAsey v. U.S. Dept of Navy*, 201 F.Supp. 2d 1081 (2002) in which as-builts were placed in evidence for a wrongful death suit, and *Hess v. Murnane Building Constructors Inc.*, 306 A.D. 2d 824, 762 N.Y.S. 2d 212 in which as-built drawings were not admissible as business records of a university.

⁴ One definition is that it must be a physical or measurable change, is permanent and better the understanding of what is now present.

purposely excluded as source information. These might include information found in approved submittals, anything associated with a contractor's approved work plans, testing results and chosen "or equals."

- Identify the required caliber of person responsible for ABs in each organization that makes up the construction team (contractor/subcontractor/CM/engineer). Define the role and authority of each in the process. Briefly, the contractor's role could be collecting information, drafting and assuring accuracy. The CM's authority may be ordering confirming surveys or excavating to confirm a condition. The engineer's authority may be to require a professional engineer's stamp on a particular contractor-made change that is deemed a design.
 - ✓ Further describe the expected level of effort.
 - ✓ Address whether it is appropriate to separate the ABs set among specialty contractors for their respective work scopes.
 - ✓ Explain the obligation of the general contractor to review and approve the ABs of subcontractors and custom manufacturers before submitting them to the CM.
- Address how the ABs will be protected from loss or abuse (i.e., always kept bound, never leaves the site office, not used as a scratch pad and properly identified as ABs on the cover sheet).
- Drafting Standards.
 - ✓ Describe drafting standards (line weights, sectioning, leaders, etc.) to be used, knowing that the majority of engineering schools now teach CAD instead of mechanical drawing. Drafting clarity may be important as they might someday be reduced to half-sized plans. It might be appropriate to follow the designer's drafting standard used in the plans. Alternatively, it may be appropriate to draw freehand versus using straightedge and scale.
 - ✓ Provide examples to show proper replacement of text, dimensions, object lines, leaders and acceptable clouding. Include examples of how to properly void an entire detail or drawing. Address accuracy of field measurements before documenting the measurements. Provide guidelines as to what should be more appropriately documented in specifications versus shown on drawings.
 - ✓ Address the use of ink versus pencil, as marks will need to reproduce clearly when photocopied.
 - ✓ For traceability, show examples of proper referencing of source documents, initialing and dating the change.
 - ✓ Revision blocks – are they used by the contractor or are they reserved only for Record Drawings?

- ✓ Propose how to handle situations where no room is available to properly show a change.
 - ✓ Address how to handle generic changes – i.e., one document requiring a change that covers many drawings and situations.
 - ✓ List the practices to be avoided, such as stapling source documents to plan sheets, use of White-Out, writing outside drawing's borders or backside, and explain why they should be avoided. Include acceptable practices, i.e., partial clouding, taping and reducing added details to fit.
 - ✓ Discuss the timing of entries to make them usable during construction. Documenting a required change two months after being directed to make the change is not beneficial to a living document.
 - ✓ Address special situations and the recording of "watch points." A watch point might be an overstressed electrical cable that was allowed to remain, an added medium-voltage underground splice or a soft pipe trench invert that was bridged by aggregate.
 - ✓ Discuss special AB concerns or nuances particular to certain types of work or major Construction Specification Institute divisions, such as mechanical. Explain special AB considerations between different fields of construction; for example, electrical work versus paving work, or a nuclear plant project versus a marine project.
 - ✓ Explain the value of adding explanatory notes for the benefit of the CAD operator for when RDs are produced.
 - ✓ Explain how to document a change over an already recorded change or what is called "as-building an as-built." This might be desired to maintain the historical evolution on the job.
- Include appropriate '**AS-BUILT**' rubber-stamping of each sheet and provide a stamp design. Provide the minimum required text in the final cover transmittal by the contractor when formally submitting them. Address similar declarations to be made by the CM when submitting to the owner. Address the benefits of making incremental AB submittals to the CM as work is completed. In the letter transmittal, address the need to note items of change for which recordable data was lost or never obtained as an alert to future users.
 - Address how to incorporate a change made that was not appurtenant to the work scope. This would be when the owner uses the current construction contract to do other work that was not finished by a prior contract, or when the owner used the current contract to get unrelated work done.

- For revised drawings that are issued during the course of the construction, should AB information be carried forward to the revised drawing and the old revision removed?
- Explain the monthly review process. Explain who reviews the ABs (just the CM?) and whether a subcontractor's ABs should be reviewed. Propose how many days before the payment cut-off date the review should take place so the contractor can revise them to ensure his payment is processed. Discuss causes for automatic AB rejection by the CM, engineer or owner. Include strategies to quickly check for new and proper entries. Merely turning sheets to make sure red marks appear does not constitute a review. Explain when is it proper to submit final ABs – after beneficial occupancy? – as a condition of Certificate of Occupancy? – after punch listing? Address the final review before job closeout. Cover final routing among project staff (i.e., does the inspector and surveyor agree with what is provided).
- Provide various flow charts of the process from documenting, reviews, approvals and final submittal. Different flow charts might be appropriate among traditional, design-build and CM-at-risk delivery methods.
- Prepare model specifications that CMs can propose depending on the project delivery method, the nature of the work and client needs. The CM can then tailor the specification based on the specific requirements of the project.
- A manual on ABs would not be complete unless it also covered Record Drawings (RD).
 - ✓ Clarify the difference between RDs and ABs⁵. Should the industry continue to let them be used interchangeably?
 - ✓ Explain when RDs would be appropriate. Will RDs merely be the approved ABs or will the wet-stamped original drawings be revised by the engineer? Perhaps the original CAD files should be updated instead.
 - ✓ Discuss the responsibility and process for producing RDs from ABs including outsourcing. Is the CAD operator the one who decides what is to be included and what is excluded in the final record?
 - ✓ Pro and con liability discussions when sealed by a professional engineer. Alternatively, who holds the liability if they are merely accepted by the engineer?

⁵ RS Means Illustrated Construction Dictionary does not differentiate between AB drawings and RDs. This is not surprising, as both terms have been used for each other. The dictionary states both ABs and RDs are made *during* construction. Perhaps usage of the terms has evolved. This author's experience is that RDs are as-constructed documents made by the Engineer (CAD or hand-drafted) from information he derives from the contractor's ABs and chooses to include.

- ✓ Consider RD management, archiving and retrieval, including electronic and hard copies to the CM, engineer and the client. Include contracting with data storage companies for long term storage of electronic media. Explain the value of the CM retaining copies of both the construction ABs and RDs for the benefit of his firm or as an added service to the client.

The foregoing should provide a starting point for the proposed standard. Note how many questions were posed. The foregoing should also reveal some of the many facets of the AB process and the fact that all aspects of ABs could not possibly be addressed in construction specifications.

A comprehensive standard is best presented in manual format. An optimistic goal would be to produce a general, useable and a widely accepted manual for use across the entire construction industry. All or part of the manual could apply to a particular construction contract depending on the needs of the owner and CM – the portions that do apply can be specified in the construction contract. AB requirements unique to a project or its owner, and not addressed in the manual, could always be addressed in project specifications.

For the sake of the contractor, the manual would need to be divided into sections applying strictly to the contractor and to other stakeholders. That way the contractor need only refer to what applies to him. Otherwise, if too complicated, a manual could defeat its purpose. A complex standard may overwhelm a contractor who is responsible for a \$1 million job. Therefore the standard would need a lower threshold or would need to be tiered by higher standards as job complexity and constructed value increases. The manual should be generic to all types of construction, job tested, updateable and have the backing of a large professional organization to promote its use. It must be able to provide clear direction in basic areas and set appropriate guidelines in all other areas.

A national AB standard would help to establish a common framework for the CM industry. The manual could be offered to clients for incorporation by reference in construction contracts, similar to the way that other national standards are incorporated by reference. Likewise, the standard could be incorporated by reference into agreements between the owner and CM. If ABs are considered part of project delivery, the standard would be another tool the CM could use for successful delivery.

Penalize or Pay for the Work

An as-constructed record is of great importance to the owner. As previously discussed, the importance of ABs are evident when the owner is able to use them 1) to refer to where things are, 2) eventually as demolition drawings and 3) for land-use history. Having such important and valuable uses, the owner expects the contractor to devote resources, meaning labor costs, to providing an accurate and complete record. The contractor, however, is compelled to minimize his costs and maximize his profits. The contractor reduces costs by putting forth the least effort necessary. However, if the owner paid directly for the labor needed to produce ABs, the contractor would spend as much time as the CM believes is necessary. Owners, however, do not allow for

direct payment, as the effort is considered by contract as “appurtenant to the work” and is thereby covered under other pay items. The bidder is expected to account for the effort by spreading his costs (overhead) into other pay items.

The effort and its cost, although appurtenant to the work, conceivably confuses the principle of work versus reward. Are not the ABs a deliverable just as an engineer's design drawings are a deliverable to his client. The engineer is paid for design drawings under one of his task orders. The current system is based not on paying for ABs, but rather on penalizing the contractor for *not* providing them. Because a contractor is paid to deliver the project, perhaps he should also be paid to deliver the ABs. A counter argument could be made that the contractor is not paid for producing the baseline schedule or making material submittals but yet these are forthcoming. These, however, are not fair comparisons because the baseline schedule is usually tied to release of the first progress payment and the contractor needs cash flow. For a submittal, it would be too risky for a contractor to start incorporating materials before his proposed products are approved. Then how about submittals such as warranties and O&M manuals that are submitted at the end of the job? Again, not fair comparisons, as a one-year warranty requires little work; it does not take much effort to change a boilerplate warranty to a form the CM likes. O&M manuals, although requiring effort, are usually a collection of material already in print, and need only be properly assembled, indexed and a cover added. Both the warranty and O&M manuals are, in effect, self-policed submittals, as those who provide them want their subcontracts closed by the general contractor. How can CMs penalize versus how can they pay for AB work?

Penalty Option 1

Take the traditional approach and recommend withholding the progress payment. This is the current industry standard and will not be discussed here.

Penalty Option 2

Develop a dollar valuation for each drawing sheet deemed not AB, missing or found substandard. A “deduction formula” could be established to determine the value of each drawing. The formula could be as simple as one percent of contract award value divided by the number of drawing sheets comprising the original contract. This would put the value of each drawing in the range of \$500 to \$1,500 – an amount that would get the attention of any contractor. One-tenth of one percent may be more appropriate if obtaining quality ABs is viewed as less important. The owner's recovery would be under a unilateral deduct change order taken at the end of the job. Any deduction formula would need to be written into the construction contract. Hopefully the contractor would realize early in the job not to be in a position to invoke this penalty.

Penalty Option 3

For those contracts that allow for administrative deductions, a penalty could be taken from the latest progress payment request. The magnitude of the penalty could be roughly calculated by how many engineering hours the CM estimates it would take to bring them into compliance (i.e., reviewing change documentation, coordinating with inspectors and contractor's field personnel and drafting). The contractor could recover

the penalty when the ABs were brought into compliance and he would be encouraged to do so. If money was not offset by an administrative deduction, the offset could be taken against money left in retention. A letter to that effect would follow the monthly progress payment.

Penalty Option 4

Advise the contractor that it will be recommended that the owner refuse either to accept or close out the contract. This assumes ABs have never been reviewed during the course of work and do not appear to be forthcoming after the end of the project. Refusing to close out the contract for missing ABs would be for the most important work where ABs are critical. This would tie up retention. Eventually the surety would start asking questions, if not already alerted by the CM.

Incentives

Penalizing for deficient work is usually not the best approach. Contractors are experienced at negotiating their way out of penalties. Better results are obtained when the contractor works with incentives. Construction contracts should be written with built-in incentives. Moreover, contracts should be written in positive prose to the greatest extent possible. Here are two incentives.

Incentive Option 1

Contractually require the contractor to outsource the AB work to a consultant⁶. Payment for acceptable work would be made via an allowance in the bid schedule. A minimum dollar amount would need to be pre-assigned in the bid schedule; of course the bidder could offer a larger value. The contractor's proposed consultant would need to be approved by the CM soon after NTP. Approval could be based on resume/interview or work sample/approval approach, similar to other submittals. The consultant would be expected to visit the work site, gather information and document work on a part-time basis, or perhaps full-time on large and complicated projects. The consultant could justify what was done each month and invoice under the bid allowance. Work done must be commensurate with the invoice and the burn rate would need to be monitored. Eventually the contractor's consultant would need to certify the AB work, with the general contractor counter-certifying the work of the consultant as his agent. The gain is that the consultant would perform work under a professional service contract with the general contractor. The consultant would have only one role and, being task-focused, not be allowed to do other work on the job for the contractor. The downside to this approach is that it would create a new industry and would probably add to the cost of construction. Therefore, the benefit versus its cost would be the driving force under this incentive.

Incentive Option 2

A better approach would be to have a lump sum bid item for ABs, with a minimum dollar amount pre-assigned in the bid schedule. The minimum amount would need to be decided between the owner and CM and be commensurate with the number of drawings and the level of effort expected. Fifty percent of the bid item would be

⁶ Phair, Matthew. "Accurate 'As-builts' Worth Their Weight in Gold," [Building Design & Construction](http://www.bdcmag.com/magazine/articles/b02i029.asp), 09/01/2002 <<http://www.bdcmag.com/magazine/articles/b02i029.asp>>

payable in monthly increments for acceptable AB work done. The final fifty-percent would be paid after final submittal and approval. With this incentive, the contractor would know and appreciate that every month there would be a direct reimbursement from the owner on his progress payment application. If the contractor did not do his work, or if it was substandard, no payment would be made under the AB bid item for the month. For lackluster efforts, the CM must be prepared to explain the deficiencies to the contractor. The contractor would be encouraged to recover payment the following month by correcting the ABs.

Sharing Responsibility

The contractor is responsible for producing the as-constructed record. He is also responsible for it being thorough and accurate. The requirement for providing the record is stated in the specifications and the accuracy needed is either specified or implied. Construction managers need to reconsider whether their clients are properly served by placing this important responsibility solely upon the contractor. Clearly, the CM understands more than the contractor the importance of maintaining the job record during the work and receiving a complete and quality record at project completion. Is it reasonable to insist that a general contractor submit an ironclad set of as-constructed documents realizing that his motives points to profits, not paperwork? Usually the contractor is the low bidder; he is trying to keep his overhead to a minimum and trying to keep on schedule, yet at the same time make a profit and move onto the next job as quickly as possible. He cares little about a contract drawing after he is done using it. Is it proper to withhold an entire progress payment or even threaten to do so for questionable ABs knowing most contractors survive on their monthly cash flow? With no payment, the contractor may need a bridge loan just to make payroll; certainly impacting his bottom line and his credit score. Is it professional to point out that the contractor's marks on the drawings are inadequate when the CM most likely knows exactly how a particular detail was changed and can probably do a better job of drafting the change? With these questions and considering the issues discussed earlier, i.e., lack of motivation, perceived no payment, brokered work and differing expectations; the CM can, and should, participate in AB process. How can this be done without relieving the contractor of his responsibility (and liability) to provide them?

AB work can be changed from a one-sided process where the contractor documents all as-constructed information to a shared process where both the contractor and CM are responsible to document how the job was built. Sharing the responsibility could work as follows. Two as-constructed records would be maintained. One set would be maintained by the contractor for his traditional AB work and another set kept and updated by the CM – site manager, project engineer, inspector or all three. The CM would continue his monthly review of the contractor's set and perform his final review at project completion as usual. Concurrently, the CM would maintain and update another set of documents, independent of the contractor. This set will be called "CM/Inspector Markups." The term *as-builts* is reserved for the contractor's work. At the end of the project, the contractor would be required, by contract, to review the CM/Inspector's Markups for agreement with noted changes. Disagreements, if not resolved, would be clearly noted and made part of the CM/Inspectors markups. The markups could be either forwarded to the contractor or the contractor could review

them in the CM's office, depending on the working protocols between both parties. The contractor would be required to provide written concurrence that he is in agreement to what is recorded in the CM/Inspector's record or specifically exclude what notations for which he disagrees. For those few projects where this has been done, one finds that the contractor takes little exception, if any, to what the CM records and how it is recorded⁷. The reason is that the contractor finds no damaging notes recorded that may compromise his work record.

Contractors will need to understand that they must aggressively maintain their sets and not rely on the CM to do the ABs for them. They must also understand their liability to maintain the work record remains unchanged. Contractors will need to understand that the engineer responsible for drafting the RDs can commingle information from both the contractor's ABs and CM/Inspector's Markups. Interestingly, this would be a partial role reversal within a construction contract, in that the contractor reviews the work of the CM.

Why should this be done? There are four answers to this question. First, CMs are generally more capable than the contractor in that they can document approved changes more quickly (timeliness) and more accurately, which is what inspectors need so they can assure field work is properly done. Inspectors would be reading information drawn by the project engineers, on-site designers or other inspectors – not information drawn by the contractor. Second, the CM and his inspectors would have one place to find the latest approved changes, and therefore not have to rely on a contractor's promise of maintaining a current set. Third, it would show to the contractor that the CM is an equal stakeholder in preserving the job record – and it being a joint effort, must be very important to the owner. Finally, the owner's project records (RDs) would be more accurate and complete.

Listed below are some additional benefits of the CM maintaining a set of CM/Inspector Markups:

- The CM and his inspectors would be free to record anything they feel is important on the CM/Inspector Markup set without insisting that the contractor do the same. The CM could record more trivial details, add "watch points" and provide helpful notes to benefit the Record Drawing CAD drafter. Inspectors observe things a contractor might either miss or not believe are important. For example, it would be prudent for an inspector to document features uncovered (e.g., unknown anodes, rock fields, debris dumps, buried pipes, etc.) that would benefit future design work. The inspector may want to document an approved larger horsepower pump than was specified on a mechanical drawing. The CM may wish to record a test parameter or test result that helps explain what was built. The onsite design representative may wish to record structural observation report numbers required by the local building authority so that there is traceability to the city records.
- During the work, the CM or designer may discover important documentation not known at the time of design. He decides that it must be recorded on the current

⁷ Port of Long Beach, CA, Pier T Marine Terminal, contracts HD-S1983 and HD-S2110.

contract set for the sake of the land users (i.e., a buried tieback wall system that is inside the work limits but was not known during design, or the head of a monitoring well located below grade and below the work).

- Dual sets reduce conflicts between the CM and the contractor about what is considered an AB condition versus what is not. If the contractor refuses to show a change or believes a change is too minor, the CM can make his own notations.
- The contractor may view as-building as less adversarial and more as a partnered effort. Knowing that the CM maintains a markup set, the contractor might be more conscientious in keeping ABs current and accurate.

After the CM approves the ABs, RDs are produced. The contractor and CM versions could be combined at the end of project. Figure 1 shows a comparison between the traditional chain-of-possession versus the proposed sharing-the-responsibility alternative. The liability of the CM for providing a markup set as a part of the project record need not be of concern. This is because, as previously discussed, the contractor would be required to review, accept or provide exceptions to the CM version. If not accepted, the contractor would provide a written explanation of which notation(s) he is in disagreement with. The RD set would show both the AB and CM/Inspector Markup versions, as either case possibly to exist unless the CM decides an investigation is desired. Nevertheless, the contractor would still need to certify the accuracy of the as-constructed record he produces.

This added role for the CM and its benefits would need to be explained to the owner. Of course, it may not be appropriate for the very simplest contracts. If the owner approves maintenance of dual sets, the task would need to be written into the CM-owner agreement, as there would be a cost for it. The benefits would outweigh the cost.

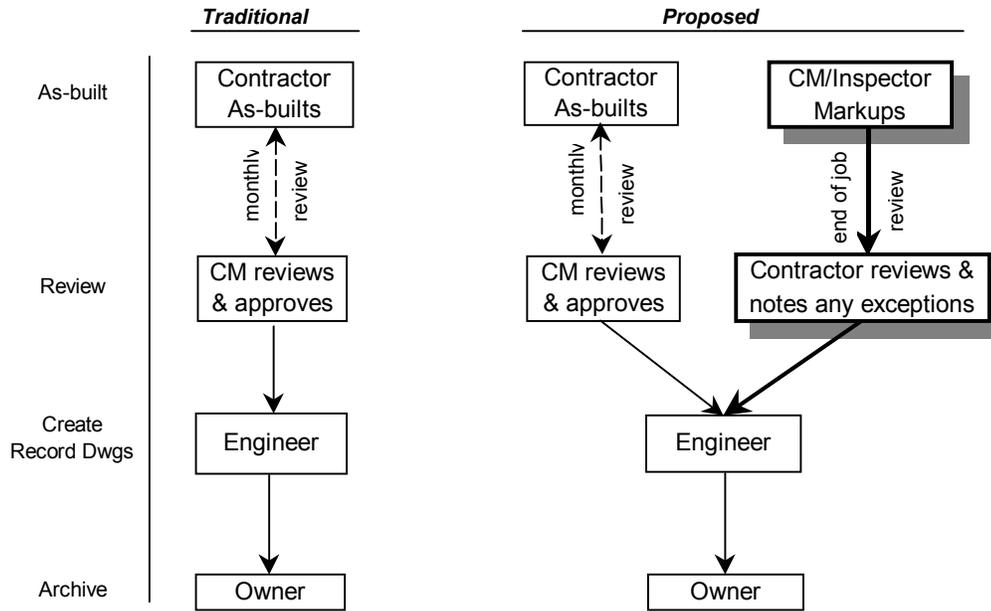


Figure 1

Conclusions

ABs provide important information that is needed during construction and afterwards. They serve as a foundation upon which to record all changes, directed or otherwise, made during the work so that the contractor's staff can quickly obtain information about any design change. After construction, ABs serve the owner as ready reference information about what was actually built. They can also serve as demolition drawings and as records of land use. Unfortunately, there can be problems with the AB process and the end results. Problems include:

- ✓ Lackluster efforts on the part of contractors and the many subcontractors/fabricators responsible for them
- ✓ The contractor's perception of not being paid for providing them
- ✓ Coordination problems due to the many subcontractors and specialty fabricators necessary to document changes
- ✓ Differences in what the owner's representatives expect versus what the contractor delivers.

To help mitigate these problems and obtain ABs that all stakeholders are satisfied with, some changes are proposed. The first proposal is to create a set of industry-wide rules or standards for AB documentation. There is a need for as-building rules and guidelines that would apply to all construction. The construction industry would benefit from a unifying, written standard. A published standard, broad enough to serve all types of construction, would fill this need. The standard could be incorporated by reference into construction contracts for the contractor to adhere to.

The second proposal is that the CM provided incentives, rather than penalties, to contractors responsible for ABs. Contractors perform better under incentives rather than penalties. The quality of ABs and the timeliness of entries would improve if the contractor knew there was a direct pay mechanism for providing them. Direct payment could be made by adding a bid item with an assigned minimum value or by providing a bid allowance that the contractor could bill against for acceptable work.

The third proposal is to change as-builting from the contractor's sole responsibility to a shared responsibility between the contractor and the CM. In addition to the traditional process where the contractor provides the as-constructed record, the CM could provide a parallel markup drawing set. At project end, the contractor would be required to review those markups for his concurrence with any notations made by the CM.

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