



Generating Accurate As- Built Drawing Sets

(Without the Headache)

PROCORE

AT THE END OF A PROJECT, HOW MUCH TIME DO YOU SPEND PRODUCING AN AS-BUILT DRAWING SET?

Do you find yourself with too many notes and marked up pages to easily incorporate into a drawing set? Or do you fear that pieces of information have 'gone missing' during the construction process, leaving you with incomplete information to pass along to the client?

This is an all-too-familiar scenario in the construction industry. And like other document control issues, it is usually a function of not having the right information in the right place at the right time. By the time drawings are produced, cumulative errors from the document management process, along with missing markups and revisions, can result in a highly inaccurate and disjointed set of drawings.

Fortunately, technological innovations are helping this situation. Construction management software companies are adding functionalities to their product suites which follow every phase of a project's construction, from estimating and planning all the way through to completion. The result is a complete record set, the product of an iterative information sharing loop that can include related RFIs, punch items, markups, and detail callouts. Because the drawings always reflect the current status of the project in real time, team members are automatically in possession of an accurate as-built drawing set upon project completion.

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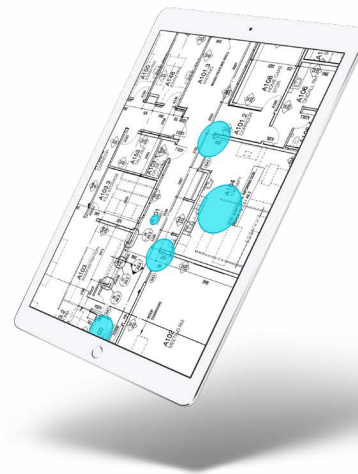
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I. What is an As-Built Drawing Set?

As-built drawings are intended to represent the finished condition of a newly built structure. The term “as-builts” is often used interchangeably with “record documents” (although legal parsings generally suggest some differences between the two).

Architects and designers are usually responsible for compiling this final drawing set, but because they are not always on site to see work being performed first-hand, they rely on drawing markups from contractors in the field. This means that owner-architect agreements typically include language relieving architects of liability for any inaccuracies. Contractual documents, therefore, are likely to place responsibility for as-built accuracy with the contractor. Often, contract language also specifies that changes be “redlined;” that is, modifications to the original design need to be clearly identifiable.





II. How Were Drawings Managed Before?

Historically, all information was tracked and captured using paper documents. In the pre-electronic world, the construction industry, like all industries, put sophisticated systems in place to organize and track their printed materials.

Rigid rules governed every aspect of construction documents, from the timing of printing to assembly requirements. Even so, keeping up effective communications between team members and maintaining updated documents proved almost impossible and costly.

Paper documents are now being replaced by electronic files, not only for original construction documents but for the contractually specified drawings of record (which are usually requested to be in PDF or CAD format). In the field, however, it is still common for markups to be done on paper. And for a commercial construction project, the amount of documents required can number in the thousands. Transferring accurate information from one document set to another is an enormous challenge.

As with document management on the administration end, standard procedures for drawing markups have been established in the field. Typically, design drawings—either digital files or paper copies—are sent from architects to general contractors, then distributed in sets to subcontractors. Subcontractors usually have

the drawings printed if they are not in paper format already, and then they distribute those papers to site personnel and staff in the job trailer. Markups and notes are red-lined on the drawings in the field and RFIs are posted with each group of subcontractors marking their own drawing set.

When revised drawings from the architect's office show up on the job site, all personnel have to 'slip sheet' their drawing sets. This means replacing updated pages—sometimes hundreds of them—and hand copying any applicable notes or markups. At the end of the job, the general contractor collects red-lined sets from all major subcontractors, or has all subcontractors copy their red-lines to a set, and this information is sent to the architect's and engineer's offices to have the markups put into CAD.

In theory, this workflow captures all relevant information. But in practice, the process often breaks down, usually in the distribution and slip sheeting of revisions. In fact, it is common to find contractors building off of outdated paper drawings on almost every job site.



III. The Solution: Real Time Data Capture

Collaborative software and real time updates are making these problems a thing of the past. By improving the flow of information as work happens, all data is captured and improved and accuracy is assured.

TOP-DOWN MANAGEMENT

When it comes to drawing management, automatic, high-level maintenance of the document hierarchy is a key benefit of project management software. Construction drawings are electronically organized into one master set and, using optical character recognition, drawings' original numbers and names are recognized and labeled accordingly. Where drawings contain references to other related sheets or detail callouts, automatic hyperlinks connect the information.

Version tracking helps all users access the most recent drawing set, while check-in/check-out, folder and document monitoring make it possible to identify who has accessed the most recent set of drawings and make sure all team members are working off of the current version. One party can manage the official updating of drawing revisions or approve changes, and the updated drawings automatically appear for everyone else on the web and on their mobile devices.

GRASS-ROOTS COLLABORATION

In addition to top-down organization, which helps even the most remote field worker access up-to-date drawings, communications from the bottom up are just as easy. Throughout the project, redlines, comments, and highlights can be added, and RFIs can be posted and be distributed to the entire team automatically. Notes are automatically copied forward between revisions. Some software programs allow field users to drop in or link to detail callouts, punch list items, sketches, submittals, and other documents. Mobile users are able to view and edit the current set of drawings even when an Internet connection is unavailable; as soon as the device detects an available network connection, the revisions are automatically synced.



IV. It's No Longer an Either/Or Situation

Up until now, real tradeoffs have been involved in the process of updating construction documents—the time spent to accurately capture all relevant data had the potential to result in significant costs.

WHEN DOCUMENTS ARE GENERATED IN HARD COPY FORMAT, TRACKING DOWN THE PROPER DRAWING SET CAN BE DIFFICULT, SINCE PAPER TENDS TO BE STORED WHEREVER SPACE ALLOWS IN THE JOB TRAILER.

Even once a drawing is located, the tasks associated with updating it can be time-consuming (stapling and unstapling sets, hand writing notes, slip-sheeting, and so on). With such a laborious process, minor changes may be deemed too inconsequential to document.

Now, however, those tradeoffs are disappearing. Real time updates, along with the ability to annotate construction drawings with a few taps of the screen on a mobile device, ensure that even minor changes,

questions and details get captured as work progresses in the field. Another traditionally time-consuming task is drawing review. With paper drawing sets, jobsite practice involves regular review of the current as-built drawing set, confirming accuracy and completeness. This type of review improves the finished as-built drawing set, but it often gets descoped because the cost is so high.

It is becoming widely known within the industry that moving from a paper-based system to a digital one saves time and money. What has been observed less frequently is that it enhances the accuracy and completeness of as-built drawing sets—which are complete, without the need for further development, at the end of the project.



V. As-Builts of the Future

Because of the known problems with traditional data collection for the as-built drawing set—and because of the impossibility of rectifying that situation by the time a project's end has been reached—as-built drawing sets have earned the reputation of being inaccurate and unreliable. But that is changing.

But that is changing. Gradually, better as-built documentation—both in terms of quality and quantity—is coming to be expected. Because of this, it behooves every project team to adopt a better system of document management in order to stay competitive.

THE NEW NORMAL

These days, record drawings are expected in CAD format and dimensions are expected to be exact. Many owners are asking for documents such as submittals and operating and maintenance (O&M) manuals to be hyperlinked to the drawings, and the more progressive owners are requesting fully digital turnover documentation.

Digitally created, real time as-builts capture the exact scope of work performed and provide a “paper trail” of versions that have been electronically recorded and verified. This makes them more reliable for legal and liability purposes. They can be used as a reference for financial or billing disputes, or as supporting

documentation to troubleshooting, investigations, or rework that is done after a building is completed. Drawing accuracy and provability is an obvious benefit in the event of litigation.

LOOKING AHEAD

Furthermore, as-built deliverables may get significantly more detailed and information-rich in the near future. The popularity of as-built surveys, produced most commonly for existing buildings that are undergoing renovation, has resulted in an industry awareness of a new kind of ‘as-built’ product. Capturing as-built information for an existing structure can be done by taking field measurements with 3D laser scanners to collect “point cloud” data—a large set of points on a coordinate system.

Currently, getting point cloud data imported into a 3D building model is a technical challenge. Raw survey data sets consist of millions of data points and, for large buildings, the data files can be many gigabytes.

They cannot be automatically imported into BIM models, but require trained technicians to interpret them and create a “scan-to-BIM” product.

Nevertheless, the overall trend is driving a change in the definition of ‘as-builts’ and the type of contractual as-builts owners expect is poised to quickly evolve. Some experts predict that instead of two-dimensional PDF as-builts, 3D model files will be widely requested by owners in the near future. Some also predict that a confluence of technologies will cause real time point cloud capture onsite to become part of a feedback loop with the BIM team. The eventual spread and adoption of these deliverables and jobsite practices is likely to be client driven, following the pattern of client-driven adoption of BIM and other technologies.

SAAS IS NOT JUST ABOUT SOLVING JOBSITE PROBLEMS OF THE PAST.

Innovative construction management software companies are staying on top of emerging trends like 3D modeling and point cloud capture. They strive to bring solutions to market as soon they are needed, integrating their products with other new technological solutions and supporting customers’ day to day efforts.

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