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Reality Capture for Construction; So I Have a Point Cloud, Now What?

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Learning Objectives

- Basic strategies for reality capture
- Strategies for identifying when a point cloud needs to be converted into a model
- Strategies for using a point cloud for 3D MEP coordination
- Strategies for how to integrate a point cloud for project turnover

Description

Today, it's very fast and easy to collect large amounts of data with reality capture technology—but what can a point cloud be used for? The obvious answer is as-built verification of existing spaces; but is there something more you can use it for? This class will focus on strategies using existing tools within the Autodesk, Inc., product line that go beyond as-builds. We will discuss examples of lessons learned and successes from integrating reality capture workflows while assisting new construction and renovation projects. From scanning to installation and beyond to facilities management; there is always something you can create from a point cloud.

Your AU Experts

Nick Dyer has been using BIM technology for the last nine years. During that time, he has adopted and applied many different methods of reality capture technology on both the design and construction sides of the industry. He has utilized reality capture for a wide range of applications, from cabinet and countertop fabrication to assisting with the construction of high tech manufacturing facilities. Nick currently works for Okland Construction where he is one of the company's Integrated Construction Team members and oversees the application of reality capture in their construction efforts.

Robert Maxfield is an Integrated Construction Manager with Okland Construction, located in Salt Lake City, Utah. Robert received his Associate of Architectural Technology and Bachelors of Construction Management, with a focus in business and architecture, from Brigham Young University – Idaho. He will complete his Masters of Business Administration from Utah State University in 2016. Having worked at an architecture firm, structural engineering firm and various construction companies, Robert is well rounded in the field of BIM. Robert is a Certified Reality Capture technician and has experience with the process of reality capture. Robert loves working with his hands restoring historical objects, and wants to push the future by capturing and remembering the past.

Basic Strategies for reality Capture

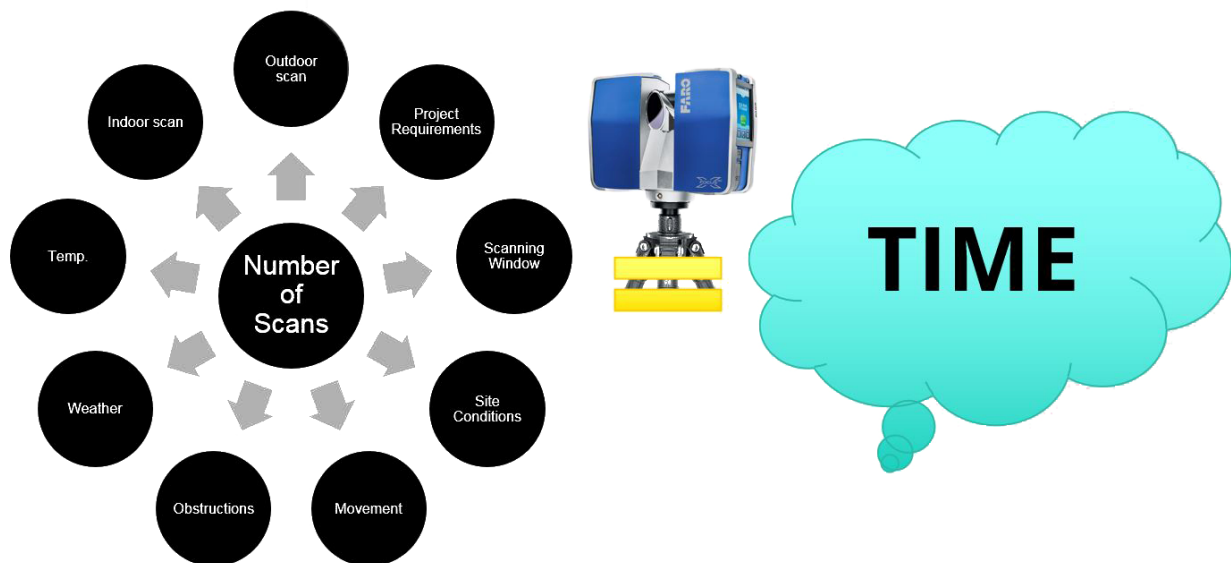
What can a point cloud be used for?

We have found success with utilizing point clouds for several activities, including but not limited to:

- As-Built during Pre-construction
- As-Built during Construction
- UAV for Site Conditions
- 3D MEPF Coordination
- Quality Assurance/Quality Control of Mock-ups
- Quality Assurance/Quality Control of Concrete
- Quality Assurance/Quality Control of Installation/Placement
- Owner Turnover

Time = Money

In construction, you need to get on a project and then off the project as quickly as possible. When determining how much time it takes to capture a project there are a lot of factors to consider. One of the biggest factors are project requirements. Despite other considerations, you have to capture certain elements of a project in order to be successful. Scanner settings can be used to help mitigate some of these concerns. Scans times range from 3 minutes to 15 minutes, when the project only requires 3 scans this may not be a problem, when you need 50 scans, you may need to more critically analyze your project's requirements.

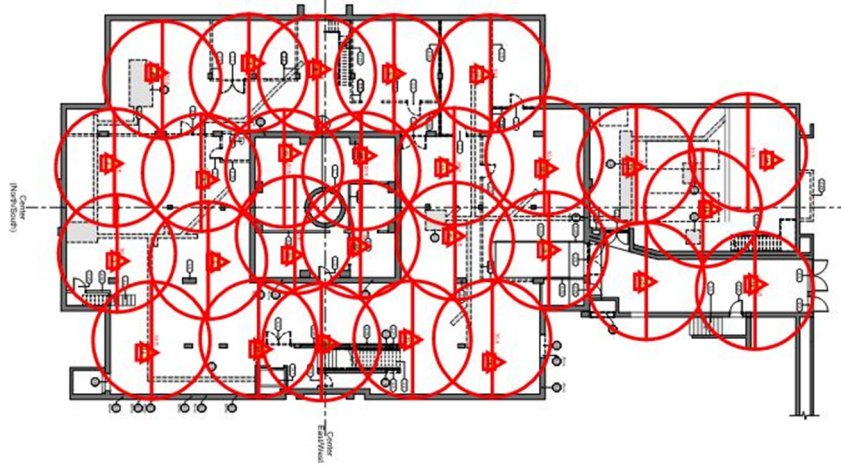


Deriving a plan

The suggested method to help determine the number scans needed, is to simply take a floor plan, Google Earth image, site plan, Nearmap image etc. and plan a route around or through the project. First, you need to determine the range of your scanner. Outdoor scans can be taken using longer range settings. The scans will take longer, (8-15 mins.) but you won't need to take



nearly as many. While scanning indoors you probably will only need to take short range scans which can take a lot less time (3-7 min.), but plan on taking more scans.



What Happens when you don't have a plan?

If you think you can walk onto a jobsite and make a plan on the fly, I promise you will spend far more time scanning than you intended. The natural tendency for anyone scanning is to take extra scans as insurance to not have to return to the jobsite. Planning out your project beforehand will force you to think more critically about your project requirements, then while you are on the jobsite, you may take a couple extra scans, you are far less likely to take redundant scans which are a waste of project time.

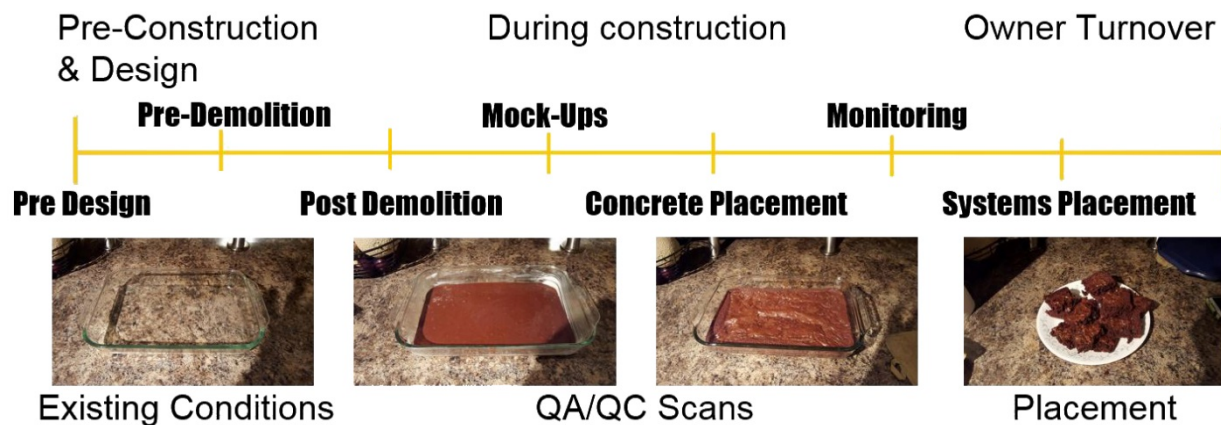
Flexibility

Walking onto a jobsite can sometimes be a like walking into a war zone. Nothing is where it's supposed to be yet, stockpiles of materials take up large spaces of the floor, demolition may be in various stages, etc. All is not lost. If you have planned out your scan project, you still know where scans are required and you will avoid the tendency to over scan. So what if your scan stations are not in your planned locations, the project requirements will still be met.

When to convert your Point Cloud into a Model

The Scanning Progression

Scanning during construction has to be timed well, or you will miss your opportunity to capture the elements you need. Again, project requirements are the biggest dictator of when your scans need to take place.



Pre-Design

Scanning during the pre-design stage is usually performed by a design team for as-built verification of an existing building. However, sometimes the general contractor will be asked to perform the scan and then turn the point cloud over to the design team so it can be used to assist in creating a more accurate working model. Point clouds created during this phase of work are almost always converted into models. Scans taken during the pre-design phase can also be used for some estimating activities as well.

After Design

After the design phase is finished, it still may be necessary to convert construction point clouds into models. Due to Autodesk and various other app developers have provided us the software tools to work directly with the point cloud. Most of the time point clouds only need to be converted into models when you are using them for 3D MEPF coordination.





The Question

You may ask the question: “If you were going to model the whole thing anyway, why take a scan in the first place?” There are a couple of reasons it is a good idea to scan and then create the model from the scan. One is when the area being modeled is very complex, for example the trusses in a gym were 30’ in the air. It would have taken several man hours to get up high enough to measure each individual truss as well as the entire room. With the scanner, scans could be taken from the floor in a couple of hours by 1 person. We were able to obtain all the information we needed and more. Another reason is even if you measured the entire space, you would still have to re-visit the site for even a single missed measurement, and model from manually taken measurements. With a scan, you already have the 3D information; you open the point cloud and trace over it to create your model.



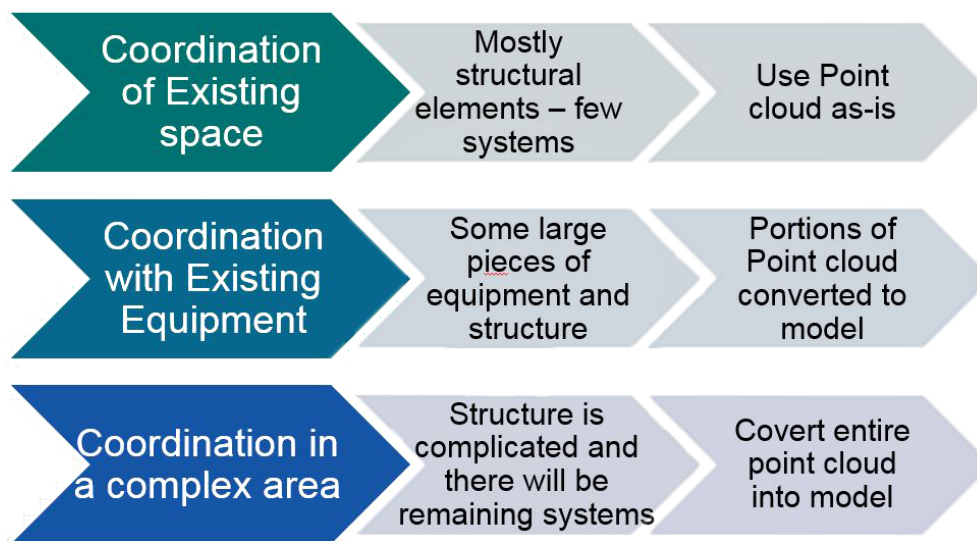
Using Point Clouds for 3D MEPF coordination

Nice to meet you Point Cloud

Using your new point cloud for 3D MEP coordination will take place between pre demolition and post demolition. There are multiple stages to consider when using a point cloud for construction coordination. some examples are; is the scan good enough to use for coordination; are there certain things that need to be modeled more accurately to clash against, etc. in one instance, we scanned the entire building because we lacked a model that accurately portrayed all 15 additions. We were able to take that point cloud and overlay it onto our model and use it to coordinate all our mechanical systems without the need to convert the cloud into a model.

On the other hand

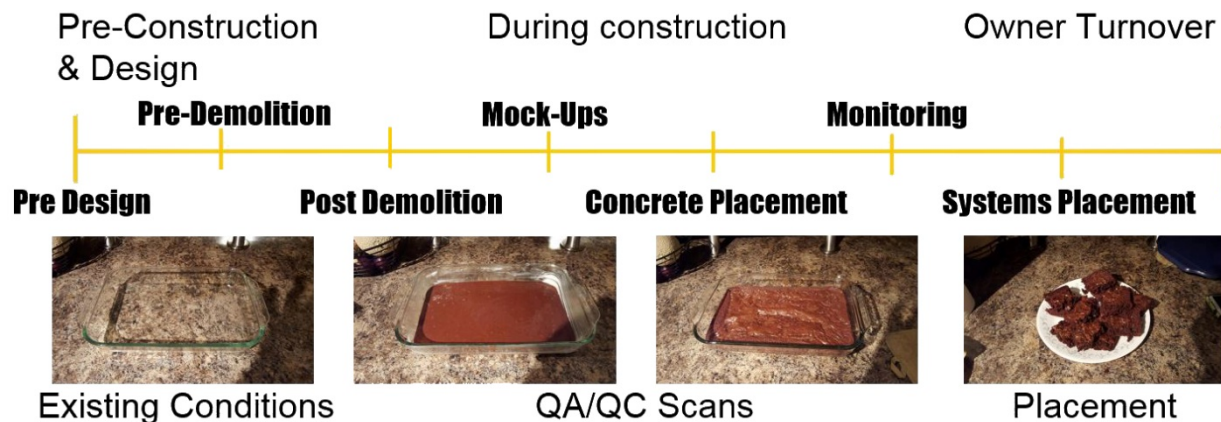
At the other end of the spectrum, we need a model from the point cloud. Another project needed a model. It needed new mechanical equipment through existing steel angle web trusses. In order to know whether we were clashing against the new modeled mechanical systems, the point cloud needed to be modeled to see exactly how close systems were getting to structure.



Integrating Point Cloud workflows for Owner Turnover

What Owners Want

Most owners are concerned with the quality of construction they are paying for, the performance of the building during and after construction, and how their building is to be maintained. 3D MEPF coordination can only go so far in helping address these concerns, so how can reality capture help?

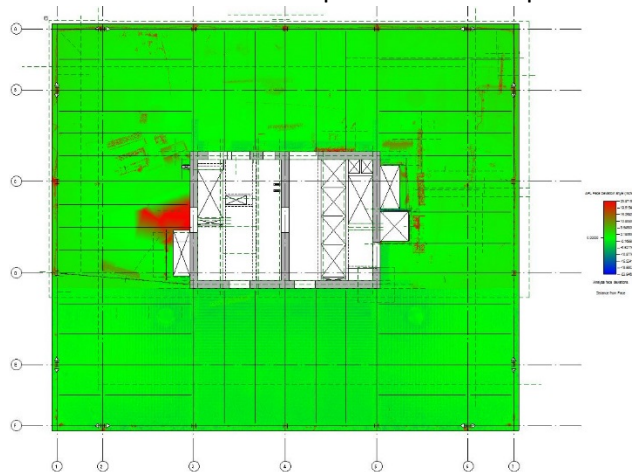


Mock-ups

Mock-ups are very helpful for owners and designers to verify quality of work and performance of materials. Sometimes these measurements can be calculated by a computer faster than can be done by a human; sometimes it takes just as long, but you're not paying the computer to sit in the corner and think. Reality capture methods allow for you to quickly capture a physical mock-up of work and analyze it. Reality capture can also be employed when you need a virtual mock-up of an existing space.

Concrete placement

Reality capture can be used to very quickly capture concrete placement. Utilizing tools within Autodesk Point Layout (APL) you can analyze slabs and walls for flatness and walls for plumb as well as placement. It is important that you always have control points in your point cloud when you are reporting QA/QC measurements



Monitoring

A great benefit to having scans is that they are very easy to compare to each other. When you have 2 scans of the same area tied into the same control points you can compare the 2 scans and have the computer tell you what moved, where it moved, and how much it moved. Two scans capture thousands more points than a traditional total station could gather in the same amount of time. Scans are also useful at collecting points that cannot be seen by a total station either due to space or obstructions.



Systems Placement

Imagine you are a facilities manager looking for a VAV box you know is somewhere inside of a conference room. Before you walk into the room, you scan a barcode inconspicuously placed in the door jamb with your iPad. Then walk into the middle of the room and face north, hold up your iPad and the scan of that room before finishes are installed appears before your eyes. You can now spin around the room and see exactly which ceiling tiles to remove. Stop imagining, because this is real. It has to be timed well, but individual scans of rooms can be incorporated into electronic as-builds and barcodes so they can be visualized in an immersive view. No more guessing if your redlined drawings are accurate, you now have visual proof of where your systems are.

To Wrap Up

Okland Construction's Integrated Construction Team

At Okland Construction, we strive to provide the best tools possible in order to create shared success between all parties involved. Our department's vision is to:

"Provide Innovative Solutions through Technology to Maximize Individual Potential"

Incorporating scanning into our processes is in direct harmony with our vision. Using the scanner in construction has increased our production, and uses the newest technology available to make others' lives easier. Scanning will save your project time and money when it is done using the correct strategy. That time and money saved can then be re-distributed to expand your horizons, whatever they may be. That leaves one question:

What can reality capture do for your project?

