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Extracting Consumable Construction Intelligence from Reality Capture Data

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Learning Objectives

- Understand current reality capture workflows and methodologies
- Use cases for reality capture – QA/QC, data rich modeling, construction planning, site logistics and progress reporting
- Discover industry best practices for reality capture
- Discover the future of reality capture – industry expectations and trends

Description

Reality capture is a process of capturing as-is conditions as images or point clouds using various means, including laser scanners, LIDAR (light detection and ranging) sensors, 360º cameras, unmanned aerial vehicles (UAVs), and more. All of these different modes spit out different output files that can be converted to usable point cloud or vector data. Extracting construction intelligence from the point cloud or vector data and sharing it in a consumable format is the key to the success of any reality capture process. This class will detail laser scanning and UAV data-capture and intelligence-extraction workflows for different use cases, such as quality control/quality assurance, construction planning, site logistics, data-rich 3D modeling, intelligent as-builting, construction progress reporting, and so on.

Speaker(s)

Chidambaram Somu (Chidam) is a Virtual Construction Manager for DPR Construction focuses on implementing innovative technologies for construction applications and new business development for the construction technology market. His areas of expertise include: Building Information modeling (BIM), BIM for FM, Reality Capture, data mapping and manipulation for construction/operations intelligence, 4D/5D modeling and model based production planning. His past projects include: Lucile Packard Children's Hospital, Arizona State University Center for Law and Society, Biomedical Partnership Building, Banner University Medical Center-Phoenix and multiple projects throughout the United States. He received his Master's from Texas A&M University specializing in Construction Management and Business Administration. He serves as a member for several industry advisory boards, is a guest lecturer with ASU and has contributed to several publications on construction technology.

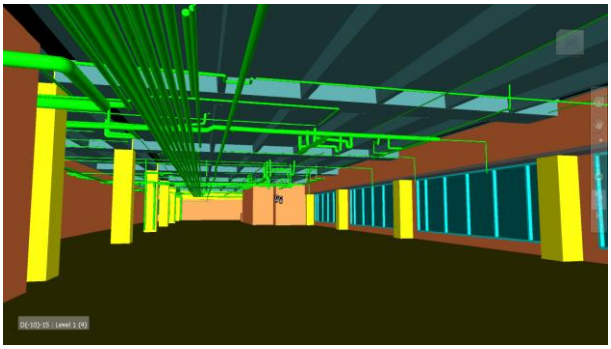
What is Reality Capture?

Reality Capture is a process of capturing rapid, accurate and reliable “as it is” conditions (above ceiling, behind walls, exterior and interior building measurements, contours and flatness) by using various means. Laser Scanners, Light Detection and Range (LIDAR) Sensors, 360 Cameras, Drones, etc. Data can be from any single source or combination of sources. Each mode produces output files that are converted to a consumable format used for:

- Quality control/Quality assurance
- Construction planning
- Site logistics
- Data-rich 3D modeling
- Intelligent as-builting
- Construction progress reporting, etc.

Current state of Reality Capture?

Reality Capture has shown many advantages in rapid and accurate data collection as compared to traditional methodologies. It has been a phenomenal tool to define as-built conditions which is primarily used for Renovation, expansion and TI projects. Below are some examples showing the exact built models generated from the reality capture data. The models generated from the reality capture data is used for design and construction coordination, as-built verification, prefabrication, etc.



Unleashing the power of Reality Capture - Different use cases

<u>As a Quality Control/Quality Assurance Tool:</u>

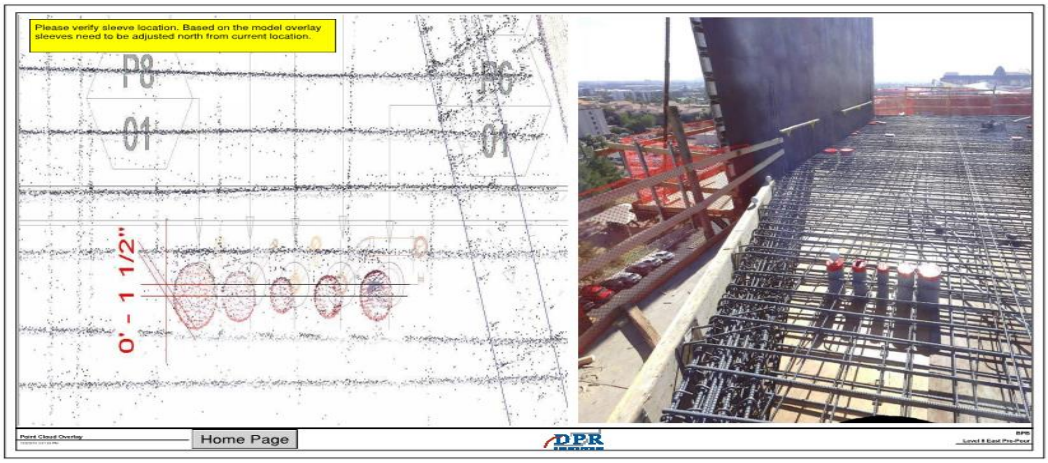
Human error exists – and this is true in construction as much as it is anywhere else. With the advanced technology of the Reality Capture, project teams could identify and fix field errors before it becomes a problem. Below are some of the Reality Capture QA/QC use cases:

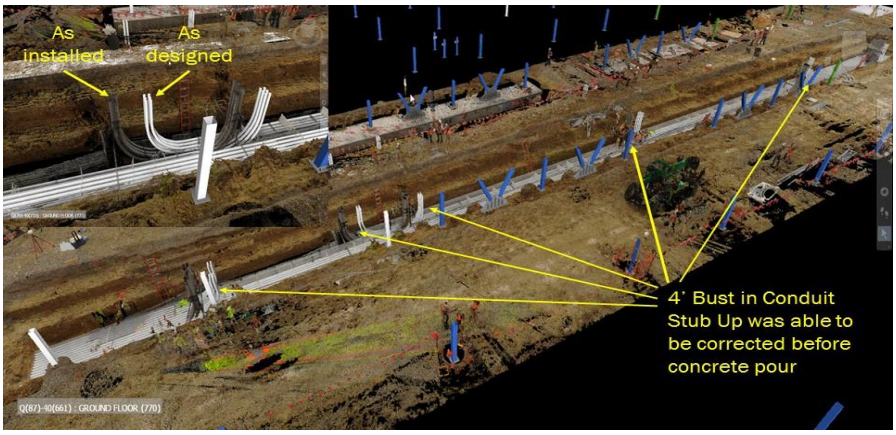
1. Verify field installs
2. Floor Flatness and Floor Levelness
3. Camber analysis
4. As-built verification

Below are the snapshots showing the use of Reality capture technology for QA/QC.

<u>Verify Field Installs:</u>

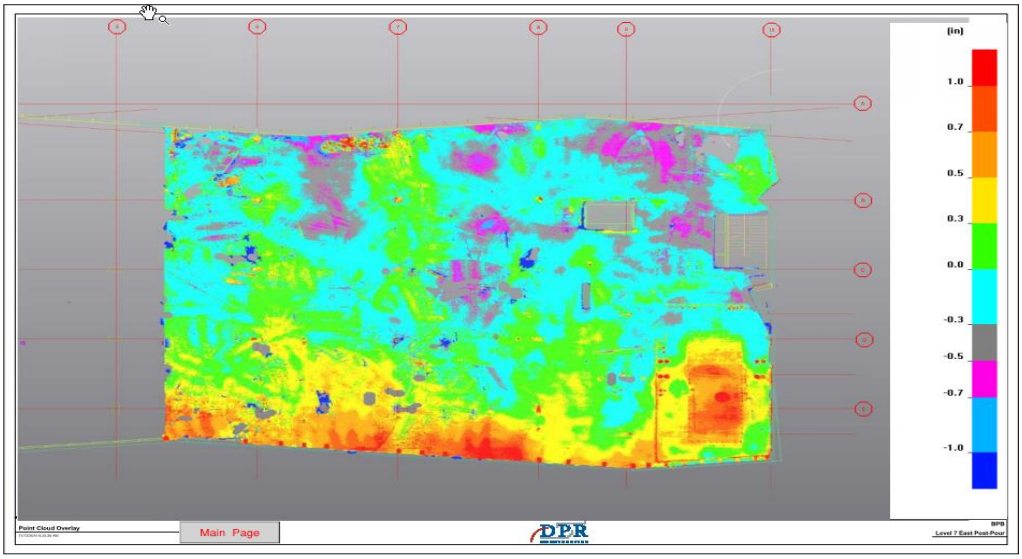
Using Reality Capture for QA/QC ensures that every component in the field mirrored its specified location on the model before the concrete floor was poured. This level of accuracy is imperative as prefabrication becomes more popular in construction. If one of those concrete floor slabs had an edge that deviated five inches from the plans, the dollars invested in fixing that mistake goes beyond the labor cost to fix that edge; there are further implied costs in the project team's time and effort to identify and coordinate a safe solution.





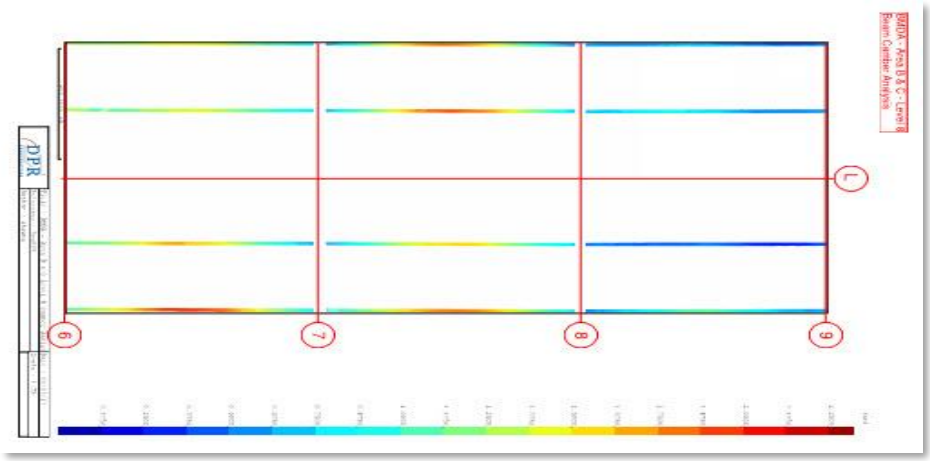
Floor Flatness Analysis:

Measurement of concrete floor flatness using reality capture technology is highly accurate, and efficient compared to the traditional methods. With a laser scanner, millions of measurements across the entire surface of the deck are captured. This data can be used to create a high precision contour map, color-coded elevation or “heat” map for further understanding of the surface variations. This enhanced information can help with better installation of equipment, proactive quality control and the ability to identify potential challenges before they become an issue. It can create an increasingly agile feedback loop of the BIM virtual environment, informing what happens on the field and back again.



Camber Analysis:

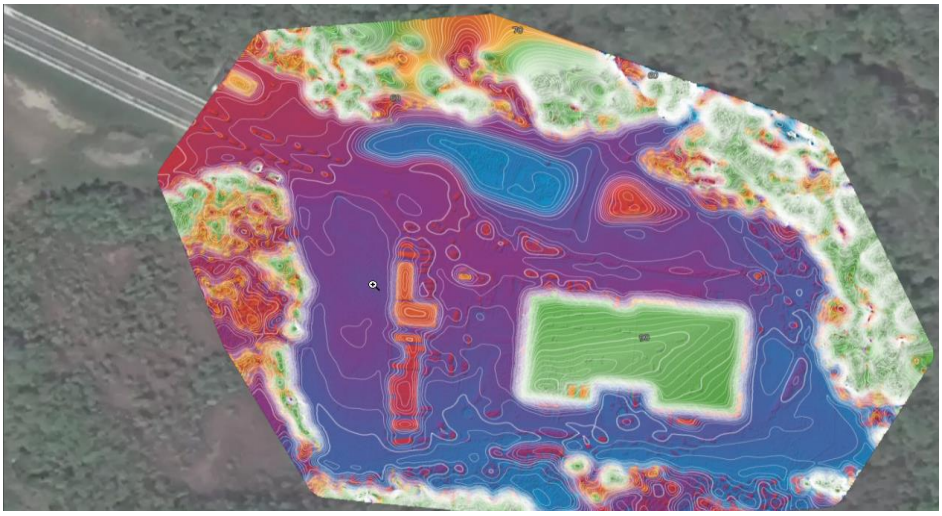
Similar to Floor flatness, using reality capture for camber analysis is faster, accurate and leaner compared to the traditional methods. The camber analysis is performed by collecting millions of points across the structural members using the laser scanner and running the plane analysis to find deviations.



As an analytical and a decision-making tool

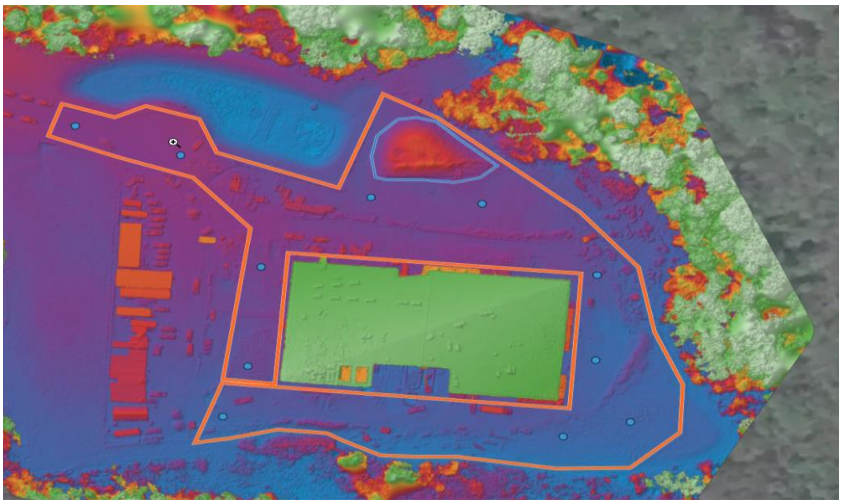
Topography survey:

Reality Capture technology (UAV's) can used to validate the topographic information we receive on projects. A UAV can fly a site in minutes. Then the photos collected can be processed and a topography map generated. The UAV can do in minutes what a survey crew does in hours if not days. Now a UAV cannot replace the survey crew for detailed analysis, but it can supplement the process.



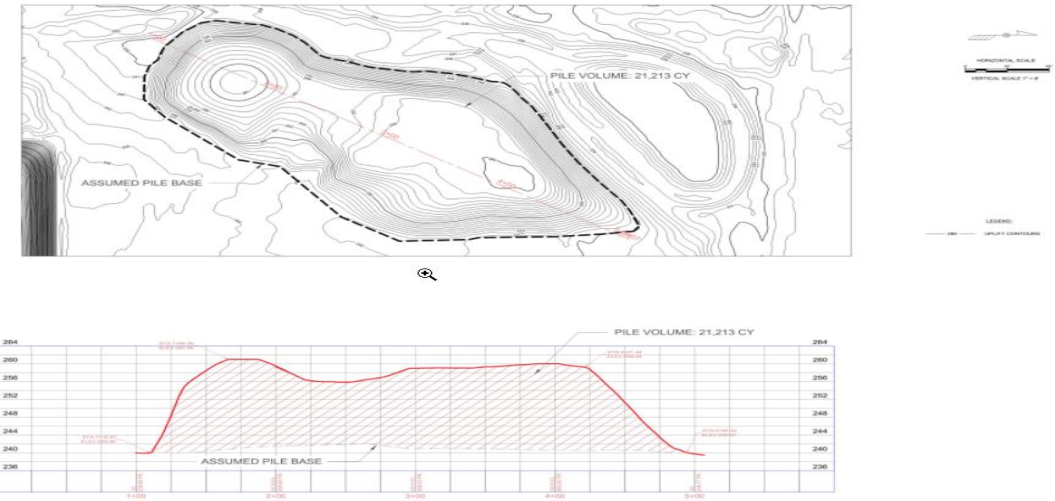
Cut Fill Analysis:

Traditionally cut fill analysis is performed by conducting a topographic survey by collecting points on the grid throughout the site. Reality capture technology (UAV) significantly reduces the manual effort involved in data collection, post-processing and data analysis. UAV can be used to help track our progress toward final grade.



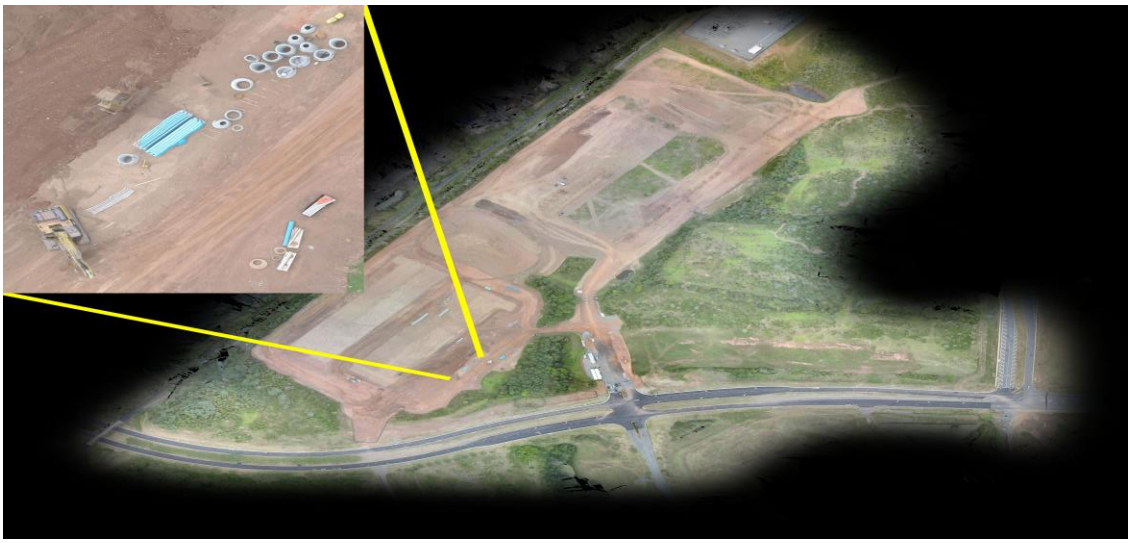
Stockpile Analysis:

The data collected from the Reality capture technology (UAV) can be used to calculate the volume of the stockpiles over time. UAV could fly over a site during the planning phase and take photos to determine the volume of the existing stockpile to better know how much dirt is going to need to leave the site. Similarly, during construction, monitoring these stockpiles can help determine how much soil has been hauled off the site. If the data collection is frequent enough, this method could be used to track the amount of consumable material available on site (Ex: gravel and sand is available for laying underground utilities).



As a Safety Tool

The Orthomosaics (It's one large photo that was created by stitching together potentially hundreds of smaller photos) created from UAV can be used for site logistics planning such as work planning, safety hazard discussions or storage location planning etc., or they can be used for just tracking progress. Any time you find yourself going to Google Maps for a satellite photo, consider using an Orthomosaics instead--it was probably taken much more recently, and you can see much more ground detail.



Who can benefit and How?

Owners and Facility Managers

- Scans create accurate “Exact-Built” documentation for facility managers post construction.
- Quickly turns the captured “Exact-builts” into a “Intelligent 3D models” for facility managers by embedding Operation and maintenance manuals, model & manufacturer info, equipment location which becomes the single source of truth for all the building information.
- Ensures accuracy in Core/Shell projects for reduced rework in future tenant improvements.

Design Partners (Architect and Engineers)

- “Exact-builts” created from the reality capture data eliminates design errors caused by inaccurate “As-builts” and also serves as an underlay for the design process
- “Intelligent 3D models” created from the “Exact-builts” help the design team with planning, systems routing and coordination with the existing Mechanical, electrical and plumbing systems for the renovation and expansion projects.
- Renovation & Expansion Uses - Helpful in older building renovations, expansions and central plant design by capturing exact plans of what is already there.

Trade Partners (Sub-Contractors)

- Design Conformance - Used to verify placement of structural components, embeds, edges of slabs, MEP sleeves, etc, with the design.
- Useful for identifying existing building tie-ins for ground-up and expansion projects.
- Accurate Exact-builts help construction planning and coordination when interacting with
- the existing mechanical, plumbing and electrical systems.
- Verifies floor fatness, camber and defection analysis in a faster more leaner manner.

Future of Reality Capture?

The entire industry is working towards an ecosystem that can:

- Consume information from various reality capture sources
- Provide analytical tools to aid the construction decision-making process
- Enhance the communication between the project team members
- Automatically identifies construction issues before it becomes a problem (AI & Machine learning)
- Provides construction progress reports, etc