Hensel Phelps

Employee-Owned
8 Districts
Markets
Aviation
Commercial
Development
Education
Healthcare
Hospitality
Justice
Mission Critical
Public
Renewable Energy
Facility Life Solutions

Diverse project portfolio
Phoenix Sky Train, Smithsonian Institution, Pentagon Renovation Wedge 1-5, SFO, Denver Convention Center, Hilton Waikiki, Orlando International Airport, Kaiser Anaheim and San Diego, and UT Dell.

World-Class Innovators, Landmark Buildings, Inspiring Performance.
Develop a plan to implement people, process and technology
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**Step 1 Pre-Planning**

*Qualified team members*

Determine different levels of experience and have a plan to train and support
Develop a plan to implement people, process and technology

Step 2 Preconstruction

Create a roadmap for Virtual Design, Construction, and Operations
Develop a plan to implement people, process and technology

Step 3 Design

Identify the tools within the tool box

Collaboration
Big Data Management
Field
Laser Scans
Augmented/Virtual Reality
Drones
Operations and Maintenance
VDC Plan of Work

Develop a plan to implement people, process and technology

Step 4 Construction
Processes to implement roadmap

- Establishing existing conditions
- Spatial Coordination
- Pre-Fab
- Progress Photos
- Easy access to consistent information
- Validation of install
- Real time site and install photo updates
- Inspections
- Proximity Sensors
VDC Plan of Work

Develop a plan to implement people, process and technology

Step 5 Handover and Turnover

Electronic eCommissioning
Validate Design model against installations
Compile background models including laser scans
Validation of 6D model information including O&Ms, Specifications and even training videos
Develop a plan to implement people, process and technology

Step 6 Services

Facilities Operations and Maintenance
- Maintenance of 3D as-built models/laser scans
- Maintenance of 6D model information for 3D as-built model
- Data integration between construction tools and owner's legacy systems
- Easy access to as-built laser scanning data
- Logic behind the data
3D Spatial Coordination

Largest Semiconductor Company, AZ

240,000 Scan Files
3D Spatial Coordination
Disconnected Project Information

- Complicated software ecosystem
- Difficult to learn, implement, and manage
- Silos of data = $$$
Construction Documents

Bluebeam Studio Share
Electronically update drawing set
Create links
Provide easy real time access
Pipe Routing Using Scan Data

Case Study: Largest Semi-Conductor Company Ocotillo Campus Tool Conversion

Because the site is so congested, trades have been using laser scan data to design their new objects, allowing them to make their design clash-free. Also they could fabricate their items based on the clash-free design.

They saved a tremendous amount of time, preventing and streamlining field work with this approach.

- Saving time
- Saving money
- Improving safety
- Increasing accuracy
Accurate As-buils Converted to 6D

Intelligent FM Solutions

Data can be loaded directly into the laser scan:

- Load installation and warranty files
- Instantly have access to repair manuals and step-by-step guides
- Capture design and installation documents
- Giving the owner/operator simple yet powerful tools to manage the facility
Intelligent FM Solutions

Logic behind the data

- Upstream and Downstream
Laser Scan Data For FM

Intelligent FM Solutions

Visibility

- Determine when assets need to be replaced
Mobile Scanner

Easier
Faster
All data collected in a single pass
Monitor your data collection as you collect it
Works with CAD and GIS Applications
Laser Scan Data For FM

Mobile Scanner

Floor Plans
In Wall Scans
Data for Measurement
GIS Integrated
Panoramic Images
BIM
Laser Scan Data For Site Logistics

Active Spatial Coordination

Integration with the BIM

Validate Site Logistics

Courtesy of ICA
Case Study: Cathedral in Maynooth, Ireland

The intent of this voluntary project was to quickly and accurately capture a beautiful and unique architectural structure as well as the statues and other detailed elements on the interior. From the scans, we created 3D models in Revit accurately depicting the geometry and surfaces of the cathedral with no impact to the structure.

Benefits:

• Capture dimensions of the entire building without any physical impact
• Create interactive virtual tour for public view to avoid physical damage to building
• Accurate structure measurement data allows the church to continue its preservation efforts and keep the original integrity of the building
Case Study: Interior of Cathedral in Maynooth, Ireland

By scanning the interior elements of this cathedral, we were able to capture not only the unique architecture of the building itself but also the unique paintings and artifacts within.

Applications:

- Capture all of the dimensions and measurements of the sculptures and art work in a historical structure or site very fast and highly accurate
- Document all the information before starting construction to be able to repair all damages that may occur during the construction
- In the event something needs to be removed or demolished to accommodate construction activities, they can be rebuilt in exactly the same place and condition

3D Laser Scanning Data

Creating 3D Model to Document Dimensions
We use 3D laser scanning to capture all information of the historical buildings with very high level of accuracy.

Benefits of our approach:

- Non-contact method of acquiring massive amount of measurable 3D data for documentation, restoration, and analysis
- There is no physical impact to the site during the acquisition of scan data
Surface Analysis with Laser Scanning

Case Study: Border Crossing Station, Nogales, Arizona

We scanned this concrete structure to determine the extent of settlement that had occurred and the surface and angles of the walls.

With laser scanning:

- We can safely obtain millions of data points in just a matter of minutes.
- We can identify misaligned façade elements by analyzing deviations in the point cloud of data.
- We can compare multiple scans taken over time to determine amount, rate, or seasonality of movement.
- We can document and quantify all changes over time.
- We can assign priority and timing for repair projects, saving you time and money.
Prefabrication

Case Study: Largest Semi-Conductor Company Ocotillo Campus

Over the course of the project at Intel, many trade contractors migrated towards prefabrication methods in order to improve quality, increase safety, save time, and cut costs. Once the laser scan data was delivered for background purposes, the pipe detailers were able to create 3D models for the pipe routing.

- Because all points are measureable, accurate depictions of the structure and its piping, ductwork, and materials are all included in the model.
- This level of detail eliminates the need to set up a Fab Shop on-site.

- Conduit runs can also be modeled. Reality Capturing allows the company to do accurate take-offs, because couplings, pull boxes, bends, wire lengths, and linear feet measurements are predetermined.
- This approach saves contractors vast sums. In turn, these savings are passed on to the owner.
Prefabrication: Safety and Ease of Use

Case Study: Largest Semi-Conductor Company Ocotillo Campus

- Having materials prefabricated and delivered in sequence limits exposure to heights and reduces bad positions and stress.
- The pre-planning can allow connection points to be in open areas, further reducing risks.
- Having a 3D measureable picture that can be virtually walked through means the installers know where they are going, preventing change orders.
- Having prefabricated components makes scheduling easier, with a smoother work flow and the ability to track progress. Tracking labels on material from the factory add to the ease of installation, reducing schedule impacts.
Anchor Bolt Configuration

Flight Simulator Building, Atwater, CA
- Foundation Surveys and Anchor Bolt Surveys to make sure pre-fabricated steel packages will install efficiently
- Scans not only capture size but also spacing

Microsoft Production Facility, Cheyenne, WY
- Quickly scan the entire roof and all pedestals
- Anchor bolts could easily be identified in both their size and configuration
- Combining the roof scans with the registered scans from the factory floor shows the entire route of the pedestal for attaching equipment
Recognizing characteristics of building rooftops including orientation, slope, and size has been a problem that was not easily solved using traditional 2D image collects.

Laser scanning technology is an excellent tool to map the distribution of trapped water in insulated flat-roof systems as well.
Case Study: Sierra Academy of Aeronautics • Atwater, California

The Sierra Academy of Aeronautics, housed at the abandoned military airport in Atwater, includes structures that are occupied as well as abandoned. **By using reality capture technology, we were able to scan the entire site.** The scans not only connected all of the buildings, but also the associated site topography. This data will be used for site planning and logistics.

**Traditional**
- Information captured in grid using surveyor estimates for key features
- Doesn’t provide the complete picture
- In a typical day, a surveyor can capture several hundred points

**Reality Capture**
- Within a few minutes, a single laser scan can capture millions of data points
- Scans can give a complete perspective of the site, including any and all elevation changes
- Deliverables can consist of contours, a 3D mesh, or a highly visual intensity map showing all elevation ranges
Post Tension Cable Locations

Case Study: ENR2 Building, University of Arizona, Tucson, Arizona

Exact points could be determined and established with laser scanning to avoid any contact with rebar or post tension cable. This saved time and improved safety since the need to drill into the post tension cables was eliminated.

Laser scans also provided an accurate representation of openings on the façade of the building. This provided a great savings in time, while providing better quality and preventing possible rework.

Reality Capturing coupled with modeling software and videography can show the owners building come to life. Flat pictures and artist renditions pale in comparison. The existing building changing into a virtual model of the dream that inspired it is turning that dream into a viable reality.
3D Animations with Realistic Textures

Case Study: Westin Resort, Maui, Hawaii

We converted a set of 2D design documents to 3D and applied realistic textures to the buildings. These walkthroughs allow architects and owners to virtually tour the designed project in a realistic environment.

This proves valuable to see the effects of design changes, as well as see the effects of material or texture changes to the project. The model can also be used to provide virtual walkthroughs for future marketing applications.

Benefits of our approach:

- Create virtual tours and walkthroughs
- See what the project will actually look like as opposed to 3D blocks
- Change textures and materials to help owners with decision making process
Change Detection

- By scanning an area twice, it is possible to detect elements that were added, subtracted, or moved.
- Accurate and easy way to validate installation quantities.
- Quickly document progress at different stages of the project.

Change detection highlights pipes that were installed (yellow addition box), as well as content that was removed (red subtraction boxes).

Changes to the work environment are quickly captured, showing the progress of work in any specific area.
Architectural 3D Modeling

Take 2D as built and bring them into 3D with laser scanning and modeling in order to get a complete and accurate understanding of the facility.
Case Study: Intercontinental Barclay Luxury Hotel, New York City, New York

The intent was to lower the existing floor into the interstitial space in order to create more space for proposed renovations. The designers needed information on the existing content to identify routing locations for future equipment and lines as well as knowing exactly what occupies the interstitial space.

With laser scanning we could draw out the data virtual 3D environment with high accuracy. Point clouds containing all details of congested areas that would be needed by design team. Using traditional methods, it would not be possible to survey the space due to a stepped foundation.
Laser scanning offers a safer, quicker, and more reliable way to collect data from confined spaces.

**Atmosphere Hazards**
- Oxygen (too little or too much)
- Toxic atmosphere
- Explosive atmosphere

**Physical Hazards**
- Loose and unstable material
- Slip, trip, and fall hazard
- Falling objects
- Substance entering through piping
- Poor visibility
- Noise
Simulations can be created to show the construction schedule sequences. The project can be animated in order to evaluate the intended sequence of events.

Realistic animations can be shown to the public, allowing them to understand the project and see the construction of the project digitally.
Benefits of 3D Laser Scanning and BIM

- Provides opportunity to use technology for project development for operations and maintenance of existing assets.
- Saves time and money when compared to traditional methods.
- Great visual tool for communication.
Access To Scan Data

Web Services

Easy and Intuitive solution to accessing scan data
Drones
Schedule updates
Real time site analysis
Safety checks
Inspections
3D Virtual Mockups

Visual tool for analysis
Augmented/Virtual Reality

Oculus Rift & Samsung VR
Virtual Reality

Microsoft HoloLens
Augmented Reality
Augmented/Virtual Reality

Why?
Virtual Mockup
Court Rooms
OR Rooms
Classrooms
Central Utility Plants
Catwalks
Augmented/Virtual Reality

Switch-on a gas turbine

Why?

Training Videos
Safety
Maintenance
Continual Education