



Combining 3D CADD with Laser Scanning

A Quantapoint White Paper

by

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ABSTRACTMeeting Revamp Project Objectives By Combining 3D CADD with Laser Scanning

The broad adoption of three-dimensional Computer Aided Design and Drafting (3D CADD) tools has resulted in dramatic improvements in design engineering productivity and quality. Unfortunately, a variety of obstacles have prevented universal adoption of 3D CADD tools for design engineering of modifications to existing facilities. This white paper explains how laser scanning technology is being used to allow 3D CADD technologies to be used on facility modification or “revamp” projects.

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QUANTAPOINT WHITEPAPERS

As the acknowledged industry leader in laser scanning technology, Quantapoint has published several papers, some of which are listed below. These are available in the Resources section of www.quantapoint.com.

- Understanding and Specifying Laser Scanning Services
- Seven Things Every Project Manager Should Know About Laser Scanning
- Contract Terms & Conditions for Laser Scanning Services
- Combining 3D CADD with Laser Scanning
- Uncovering the Value of As-Built Laser Documentation for Engineering Firms
- Uncovering the Value of As-Built Laser Documentation for the Power Industry
- Uncovering the Value of As-Built Laser Documentation for the Processing Industries

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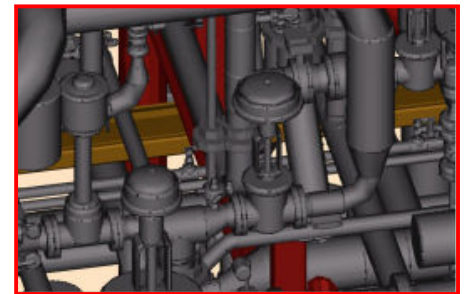
Overview

The broad adoption of three-dimensional Computer Aided Design and Drafting (3D CADD) tools has resulted in dramatic improvements in design engineering productivity and quality. Unfortunately, a variety of obstacles have prevented universal adoption of 3D CADD tools for design engineering of modifications to existing facilities. This white paper explains how laser scanning technology is being used to allow 3D CADD technologies to be used on facility modification or “revamp” projects.



3D CADD

The advantages offered by modern 3D CADD tools are numerous and well documented. For example, 3D visual model representations are intuitive for user audiences ranging from novice to expert, which can help ease coordination with project stakeholders that may lack familiarity with traditional engineering design drawings, such as steel details, piping plan drawings, and piping isometrics. Additionally, 3D CADD tools typically support integrated, multidisciplinary design work processes, helping to ensure quality and consistency throughout the design lifecycle. Other benefits include:



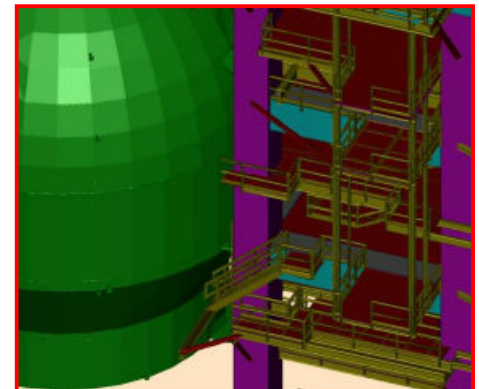
- Design standards and best practices that are ‘embedded’ and ‘enforced’ to help ensure the creation of consistent documentation.

- 3D CADD models are electronically transportable to engineering design teams anywhere in the world, improving teamwork and design efficiency.

- Facility data for tagged equipment and instrumentation can be associated with the visual model for easy lookup.

- 3D CADD tools support flexible, automated generation of legacy 2D documents such as isometrics, plans, and elevations

- Construction phase rework from dimensional and interference busts are nearly eliminated, resulting in reduced costs and schedules.



These benefits are so compelling that the use of 3D CADD tools for the design of new facilities is nearly universal. Due to the significant benefits achieved, there has been significant interest in using these same tools to revamp projects. Unfortunately, 3D CADD tools did not exist when many facilities were designed and constructed and creating CADD models would require significant time and cost. Additionally, many facilities do not even have accurate 2D documentation, such as piping & instrumentation diagrams (P&ID’s) or piping isometrics (iso’s). Even if accurate 2D documentation were available electronically, it is not possible to automatically generate a 3D model from traditional 2D CADD – manual remodeling is the only available migration path.

Laser Scanning and 3D Laser Models

Laser scanning is rapidly becoming a standard technique for the collection of as-built data for process, power and offshore engineering and design projects. An individual laser scan is composed of billions of individual 3D spatial measurement points. Individual laser scans can be viewed as photo-realistic 2D images. A series of individual laser scans can be integrated to create a dimensionally accurate, physically complete, 3D visual representation that is photo-realistic. This 3D laser model is fully digital and easily shared to design teams anywhere in the world.

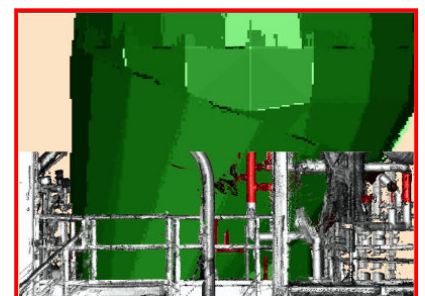
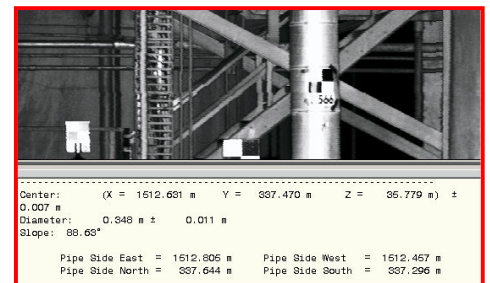
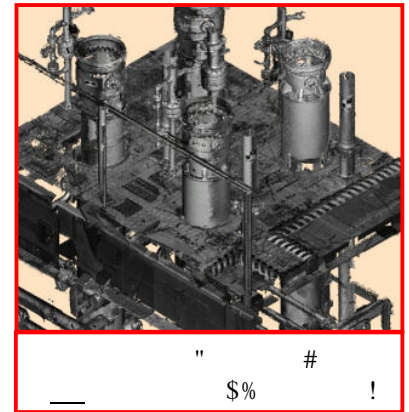
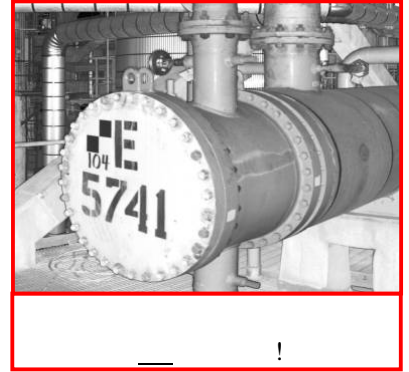
It is important to note that in a 3D laser model that while each point provides a highly accurate physical measurement of a point in 3D space, there is no difference between the measurement points on the surfaces of pipes, vessels, steel, concrete, conduit or insulation. While a 3D laser model may look like a collection of pipes and equipment, it contains no concept of the individual entities. There is no 'magic button' that will convert laser scan data into fully attributed CADD entities.

Using 3D CADD with 3D Laser Models

There are many ways in which drafters and designers can use the 3D laser model, the easiest of which is as a source for accurate dimensional measurements to create entities in the 3D CADD package. Measurements can be taken for individual points and from any point to any other point. For pipes, the centerline, angle and outer diameter can be easily extracted. This enables existing structures and piping to be remodeled only in those areas for which it is absolutely necessary, such as the connection points for new equipment and piping.

Additionally, 3D CADD models can be imported and displayed with the 3D laser model. This can be used to visualize proposed modifications for design and constructability planning, to compare and validate CADD models against the as-built laser documentation, or share proposed updates to project team members unfamiliar with CADD software. The result is more accurate and faster design and review cycles.

Finally, the 3D CADD models can be clashed against the 3D laser model to identify potential hard and soft interference or dimensional busts. This provides a work process in which design clashes are exceptions to be eliminated on the engineers' desktop, because resolving clashes during construction job is simply too expensive.



While 3D laser models are not equivalent to 3D CADD models, combining the two modeling approaches enables many 3D CADD best practices to be applied to revamp projects. This hybrid approach has been used on hundreds of projects and has consistently resulted in engineering productivity and construction phase rework rates consistent with those achieved using 3D design technologies for new facilities.

Tangible Benefits

All project stakeholders – owner-operators, engineers, designers, maintenance personnel, project managers, and equipment vendors – are likely to find that combining 3D CADD and 3D laser models can provide a significant return on investment for any revamp project. Early adopters have found it to be safer, faster and more accurate and transportable than any other option for capturing and sharing dimensional details of existing facilities.

Laser scanning is also easily justifiable for revamps to facilities originally designed in 3D CADD. Similar to 2D design documentation, 3D CADD models may also be incomplete and inaccurate. Typically, these models contain idealized representations – with all pipes being 90-degrees and plumb – and not actual “real world” features. Models also usually exclude information such as packaged equipment details, field routed utility systems, instrument conduit and cabling, and some small-bore piping. 3D laser models capture these features wherever visible and helps to address the risk of construction phase rework caused by inaccurate dimensional assumptions and interferences against features undocumented in the original design 3D CADD model.

Among the many tangible benefits of combining 3D laser models and 3D CADD models are:

Reduced costs

- Costs associated with project rework and field fit-up welds are minimized.
- Global engineering centers can be leveraged as the digitized plant can be easily shared.
- Lost revenue from not meeting shut-down and turnaround schedules is avoided.

Optimized schedules

- Time spent in plants collecting data is greatly reduced.
- Design efficiency is greatly improved by using as-built laser documentation directly with CADD models.
- More components can be prefabricated with greater confidence that they will “fit”.
- Shut-down and turnaround durations are minimized due to less project rework and field fit-up welds.

Increased Quality

- Improved sharing of more accurate information reduces many of the risks associated with project execution – better information leads to better decisions.
- Accurate and detailed information improves engineering designs and many of the decisions that affect construction and start-up.

