AUTODESK **UNIVERSITY** 2015

The Lifecycle of a 3D Heavy Civil Construction Model (Reloaded)

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As the horizontal construction world continues to catch up with the vertical world, we will once again dive into the use of 3D heavy civil construction models and the workflow associated with them. We will cover the benefits of using a 3D model, starting at the bid, going through construction, as-builts and finally operations and maintenance. Shown through the eyes of a contractor, we will share both field and office experiences while displaying project examples. We will discuss creating models for bidding, procuring field data to support 3D models, including UAV's (unmanned aerial vehicles) and laser scanning, using AutoCAD Civil 3D software to build excavation models for quantification, AMG (automated machine guidance), modeling to determine means and methods, utilizing the 3D model in the field for stake less layout, and using Navisworks software. We will also cover VDC (virtual design coordination) with owners and subcontractors, decreased turnaround time on requests for information / change orders, safety benefits, point clouds, and fabrication plans.

Learning Objectives

At the end of this presentation, you will be able to:

- Learn why building 3D models for the life of the project is important
- Discover how UAV's and laser scanning are used to supplement field data procurement
- Discover how the use of 3D models helps every general contractor
- Discover the benefits of using 4D modeling and Virtual design and construction

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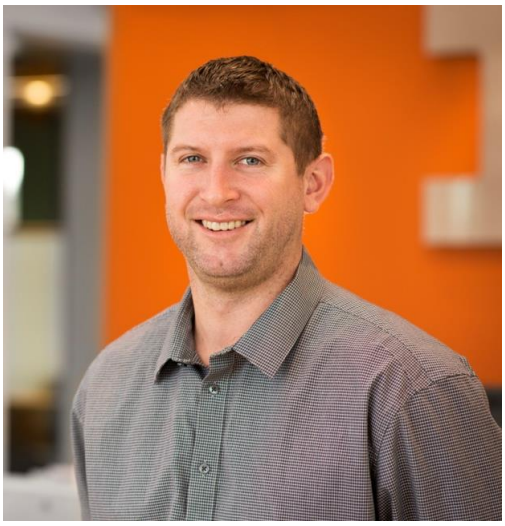
About the Speakers

Brian K. Smith



Sam Kloes

Brian Smith is the director of Technology at IMCO General Construction, Inc., in Ferndale, Washington. He oversees the VDC (Virtual Design and Construction), IT and GPS groups and specializes in VDC, 3D design, modeling, Building Information Modeling (BIM) coordination, and various data procurement methods including UAV photogrammetry, laser scanning and Lidar. Brian has been designing heavy civil projects for 18 years, including hydroelectric, water/wastewater, industrial, road, and bridges. He specializes in Autodesk, Inc., products and is proficient in AutoCAD Civil 3D software, Revit software, Revit MEP software, and Navisworks project review software. Brian is also an AutoCAD Civil 3D and Revit instructor at Washington Engineering Institute, and he presented at Trimble Dimensions and Autodesk University and HC4 2014. BSMITH@IMCOCONSTRUCTION.COM

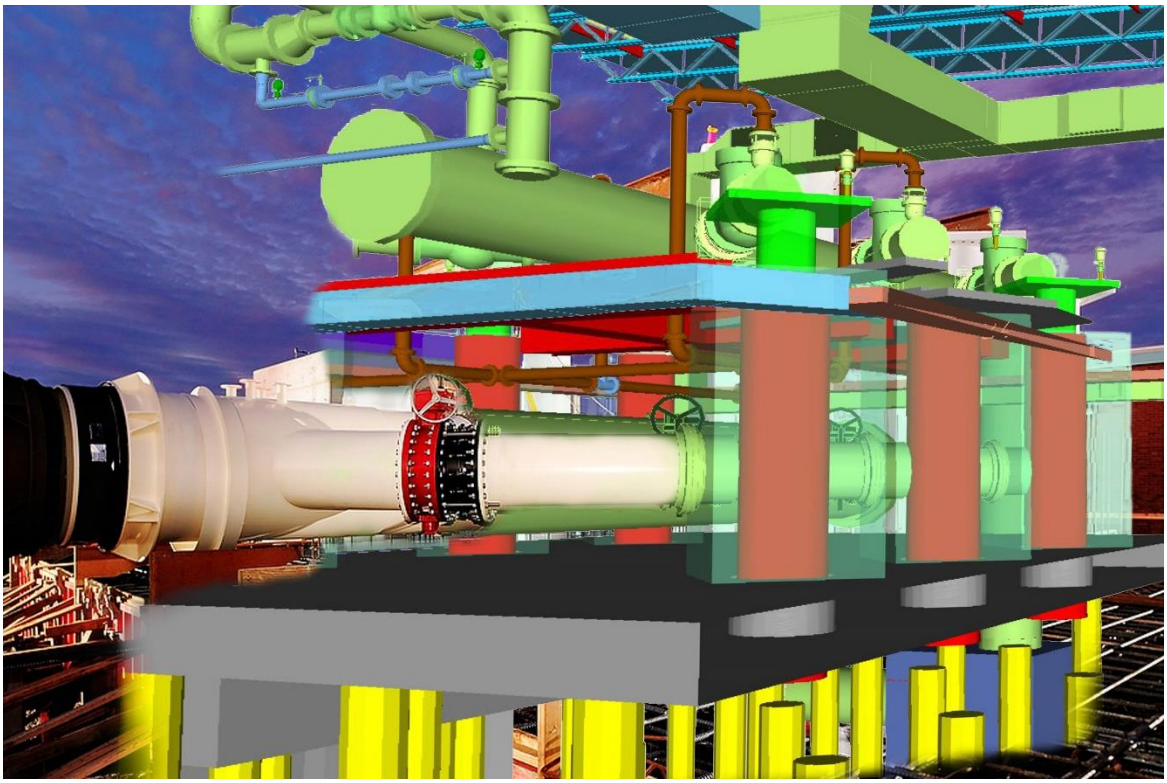
Sam Kloes is the GPS and Survey Manager at IMCO General Construction, Inc., in Ferndale Washington where he has worked for the past 8 years. Sam Oversees 3D Surface and Utility modeling, site surveying activities, and a fleet of GPS Automated Machines.
He has 14 years experience in heavy civil construction and Sam has surveyed and modeled more than 80 projects over the past 8 years in the northwestern United States, Cuba and Guam. Sam is also a Robotic and GPS Survey instructor at Washington Engineering Institute, NCCER Certified Instructor and presented at Trimble Dimensions and Autodesk HC4 2014. SAM@IMCOCONSTRUCTION.COM

Introduction

We are back and reloaded with an updated more in depth discussion! Everyone has heard and or read about design and construction acronyms like BIM, CIM, AMG, and VDC, but how do contractors use all of these together in the real world on a day to day basis? One common key between all of these is 3D models and the use of 3D models at some stage of the design and construction process. This presentation will cover the use of 3D and 4D models for VDC (Virtual Design Construction) on a heavy civil construction site and the workflow starting at bidding and goes through construction and final as-builts, all from the perspective of a contractor. Professional presenters will share both field and office experiences while displaying project examples. They will discuss importing various types of PDFs, importing CAD files for bidding, using contractor surveying to support 3D models, using AutoCAD Civil 3D software to build excavation models for quantification and automated machine guidance (AMG), modeling to determine means and methods, using the model for collaborative design with owners and subcontractors, using AMG for increased safety, and utilizing the 3D model in the field for layout and the collection of additional as-built data. We will discuss leveraging new tools that integrate with your existing workflow like UAV's and laser scanning to provide faster more accurate field data. I hope this presentation will help you appreciate 3D models, the technology behind them and give you a better understanding of how a civil general contractor utilizes them to increase efficiency, accuracy, and quality.

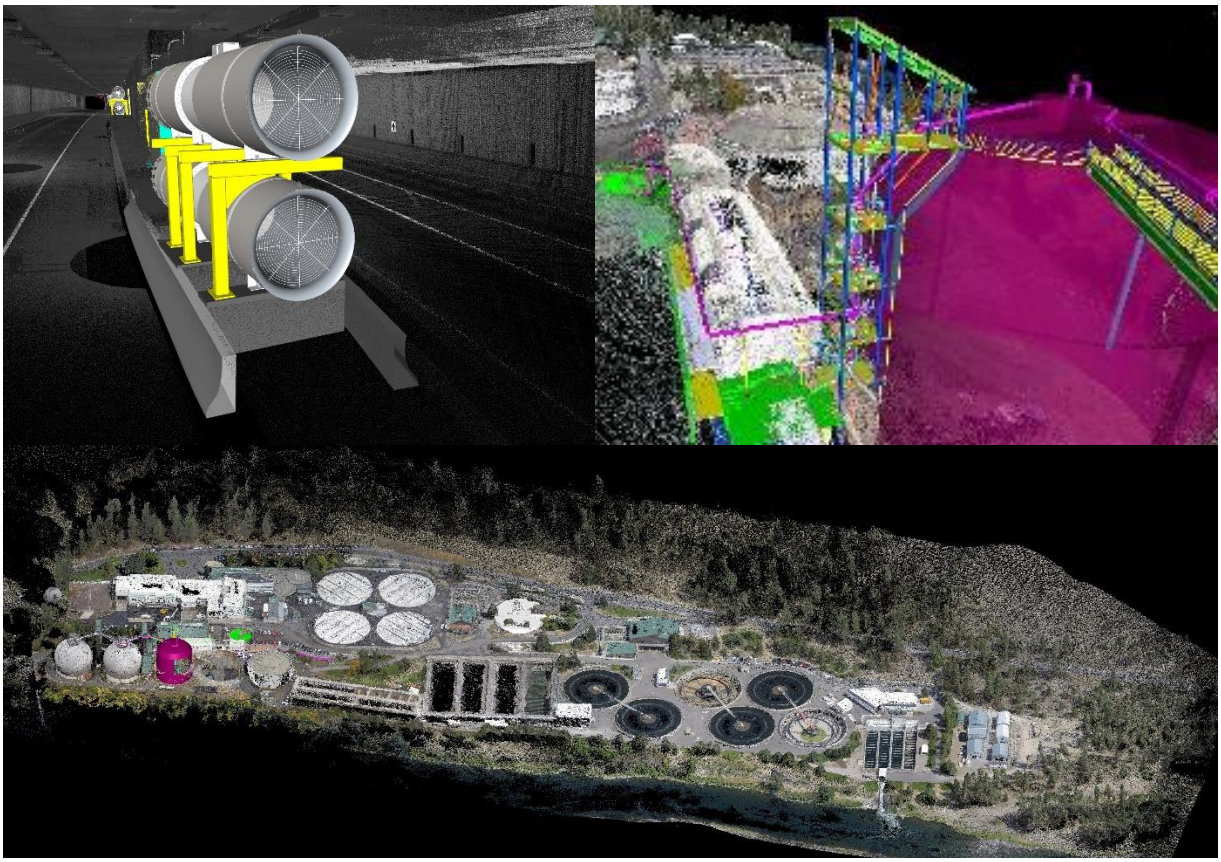
Lean why building 3D heavy civil construction models is important for the life of the project

Let's begin the 3D model building process with the available data provided. When building a model, the level of detail and accuracy is determined by the individual task, available data and resource allocation. Typical areas we use 3D models; quantity takeoffs, planning, construction ready models, Rework(Contract and Field) and As-builts. We start with a process that we have coined "Forensic Plan Reading". One of the first steps in any project is to analyze the existing data available. The available data can vary greatly depending upon the project type, ie. hard bid, GC/CM or design build. Coordination with the project managers and stakeholders at an early stage is critical to ensure the model is not more or less than what is necessary. The available data can range from PDF's that are either raster or vectorized to a full 3D intelligent model. If there is additional data required to build the model it should be identified early. Additional procurement of data can come from traditional survey, Lidar, Laser scanning and UAV photogrammetry. Combine this data into the model with as much detail as possible for the project. With all the data together we can begin to determine construction means and methods as well as scheduling and procurement of materials. We will discuss how to utilize various software to maximize the workflow and create the best 3D model possible. Once we have the models built from the takeoff level they are always being updated and modified with better more accurate data. This helps aid the craft workers as well as the subcontractors. The BIM model is king and all things begin and ends at the model. The more accurate the model is during construction the less work that will need to be done at the end of construction to true the model up with existing as built conditions. Having a coordinated accurate model will help decrease the time during construction as well as increase productivity. Once the project is completed we will use the model for facilities maintenance and operations.



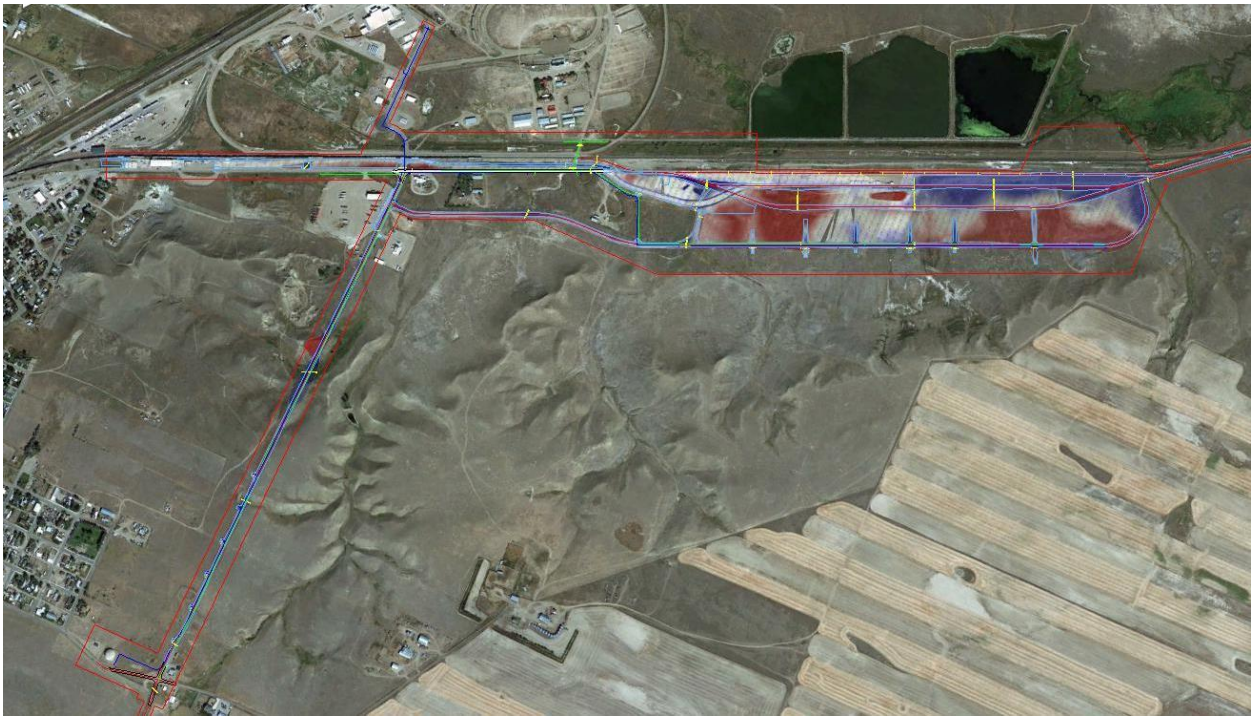
Discover how UAV's and laser scanning are used to supplement field data procurement

UAV's (unmanned aerial vehicles) have been around a long time primarily used for military applications, until 2012 when UAV's size, complexity and cost came down. Laser scanning on the other hand was invented in the 60's, but did not get much attention until technology caught up with the idea. In the late 90's laser scanning began to get noticed but was out of the price range for most companies, until 2010 when the price and complexity began to come down. Now the use of both types of data procurement is more common place. At IMCO we model 100% of all our projects from bid to final delivery to operations. This means that the faster and more accurate we can get field data the better more informed decisions we will be able to make. This is true across the entire company and touches every aspect. The utilization of UAV's creates a safer work place by procuring field data on steep slopes that might otherwise endanger the surveyor. The images captured on a daily basis help in planning our laydown yard and staging. The data collected both from photogrammetry and video help coordinate work in our BIM model. This helps trades see the whole picture not just the piece of the project they are working on. Documentation of daily activities is recorded on the weekly production flights. The Inspections can be recorded on video or still images. These can create a safe and more accurate environment for the inspectors and QA/QC. Daily flights track our earth work production and is used to asses our workload and equipment. Stockpile quantification is similar to production but is limited to volumes of piles identified in advance to automatically perform the takeoff. Lastly we use the data from both laser scanning and UAV photogrammetry for our VDC (Virtual Design and construction) model. Having quick accurate data allows us to make the most informed decision.



Discover how the use of 3D models helps heavy civil contractors

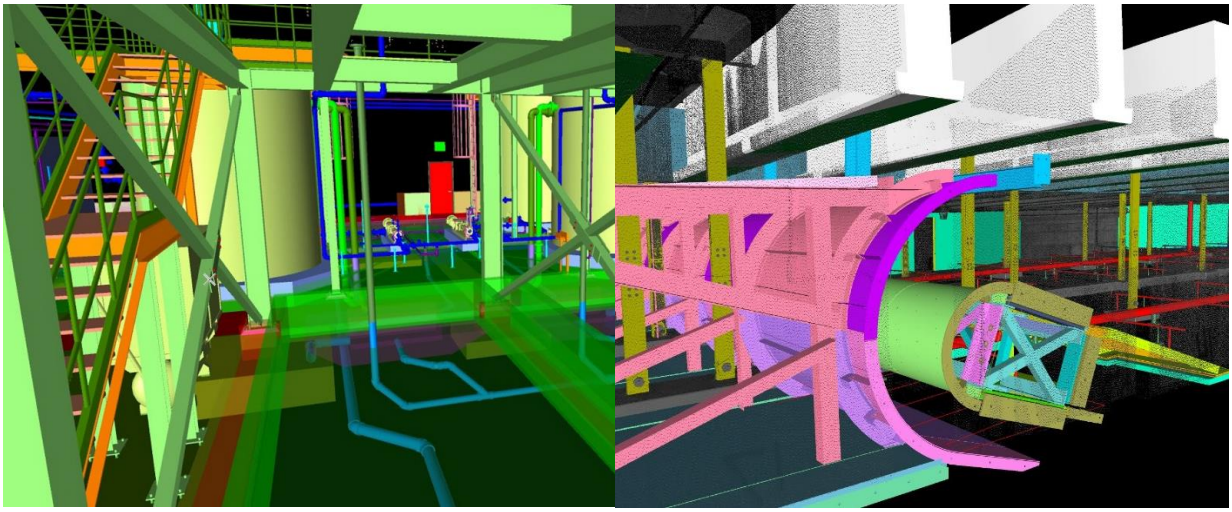
The idea of using 3D models throughout the entire project is all about data and data control. From building the initial model where you might need to collect additional data to the final deliverable there are many benefits. First the idea of sharing this data throughout the life of the project with the engineers, owners and sub-contractors removes the adversarial position for everyone. The sharing of data only helps the project move along at a faster pace with everyone's support and understanding. Autodesk Navisworks is one tool used frequently to show all parties with one model how the design aspects might affect the existing utilities in the ground in a way that cannot be done with traditional 2D plans. The use of BIM 360 Glue allows the craft workers to see the big picture, stay connected with the office and comment directly to the Project Engineers. The VDC model allows for alternative design considerations and value engineering while coordination with stakeholders. These changes can again be made quickly, accurately and then submitted to the engineer/owner in an RFI. RFI's are typically approved faster and more accurate than the traditional methods and since the RFI was generated from the 3D model we already have the new surface or data created and ready for export to the field. All of the planning still will not completely remove the unforeseen issues during a project and once again that is where Data is King. Using this additional data that has been previously integrated with the model you can quickly make proposed design changes and see the impacts they have to the site and schedule. The final step of sharing this data is providing a full digital model to the owner. Sometimes this is hard points that were recorded during asbuilts that could be used for GIS inventory and other times it is a full BIM model. These additional services are typically not required but something we provide as an added value to the client.



Discover the benefits of using 3D & 4D models for VDC

There are many benefits or byproducts of using a full 3D & 4D design and construction models and one of them is the surface that is created for quantities. This surface is the beginning of what we us to for final grading, utilities, piping, and a stake less job site! When you design, plan and build in a digital world there is no need for staking and layout. The use of automated machine guidance can be as simple as having clearing limits in the excavator or as detailed as reverse crowns with super elevation curves in a grader. The model either begins with Autodesk Civil 3D or Trimble business center to create the 3D geometry, 3D lines and corridors. Using the 3D model allows for the addition of the existing utility information to be included in the guided equipment. This allows for complete control and reduces risk of striking an existing utility. The models in the machines can be updated either through a thumb drive or a wireless network. A benefit that is often over looked with AMG is the ability for the operator to take an accurate field shot using the bucket, or blade tip. This can be used to check grade as well as a safety tool so that an inspector or grade checker does not have to enter the excavated area. When everything is done in 3D, all data has a home and is important. You might not know the significance at the time of collection but having that data available is important for future use.

Sine we already have a 3D model built for VDC we can then add time to the model for 4D. We will often combine the Model and schedule to see the implications of project schedule changes. Having a base line and being able to see the impacts to a schedule allows for a visual interpretation of the schedule as well as a baseline for change orders that impact production. This can be communication delays with subcontractors or delay impacts to owners.



In conclusion

The horizontal civil world is quickly catching up to the vertical world but the buy in from heavy civil contractors is inconsistent. As 3D models become more mainstream and the competition in the marketplace increases the efficiency gained through the use of 3D models, UAV's, laser scanning and VDC will separate those who have adopted the technology vs those whom have sat bye and watched. Planning and implementation throughout the entire project is more about data and data control. From UAV's to laser scanners there are many forms of data procurement but it is how you use the data that makes the difference. From building the initial model where you might need to collect additional data to the final deliverable there are many benefits. The use of Autodesk Navisworks is one tool used frequently to show all parties with one model how design aspect fit with existing in a way that cannot be done with traditional 2D plans. The use of BIM 360 Glue allows the field guys to see the big picture, stay connected with the office and comment directly to the Project Engineers. The VDC model allows for alternative design considerations and Value engineering. These changes can again be made quickly, accurately and then submitted to the engineer/owner in an RFI. All of the planning and modeling still will not completely remove the unforeseen issues during a project and once again that is where Data is King.