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Reimagining BIM for Civil Engineers – Underground Utilities

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Learning Objectives

- Discover the history of object modeling for underground utility infrastructure in Autodesk's software package

- Discuss what went wrong and what went right for underground utility modeling in Autodesk's software through the years

- Discover ideas on engagement and wider adoption by both the engineering and product-manufacturing communities

- Brainstorm what can be done to improve underground utility modeling in future releases of InfraWorks and AutoCAD Civil 3D

Description

Civil infrastructure industry professionals, product developers, and technology evangelists are invited to join a roundtable discussion on how we might reimagine the way Building Information Modeling (BIM) for civil engineer is implemented. In this session we will focus on how underground utility piping has evolved in Autodesk, Inc., software, beginning from Land Desktop software, continuing through AutoCAD Civil 3D software, and now into InfraWorks 360 software. We will talk about what worked well through the years, what failed miserably, and what Autodesk can do in the future to improve what we call BIM for the world of civil infrastructure.

Your AU Experts

Curtis Smith is registered professional engineer (FL, TN) and BIM for civil engineering specialist at Innerlight Engineering Corporation in Miramar Beach, Florida. His engineering expertise is extremely diverse ranging from small scale residential site designs, commercial and industrial site development, and even large-scale municipal and airport stormwater infrastructure redevelopment projects. Curtis brings over 8 years of Civil 3D experience, Civil 3D Certified Professional status, prior AU Speaker status (AU 2013 – CI2170), and 2015 Autodesk Gunslinger status. He provides professional online training courses for Digital-Tutors/Plurasight for both AutoCAD and AutoCAD Civil 3D. He also is heavily involved in the Autodesk Customer Council providing ideas, development feedback, and product beta testing for AutoCAD, AutoCAD Civil 3D, and InfraWorks 360.

Matthew Anderson is a register professional engineer (IL, IN, WI, MI, TX) and is a Product Manager in the Autodesk AEC Design Civil group, responsible for civil infrastructure products. Over the past twenty years, and a number of roles, Matthew has worked on projects of all shape and size that to provide, avoid, or manage water & utilities in some shape or form.

Steve Hill is a Civil Designer at Geosyntec Consultants and Owner/.NET Developer at Red Transit Consultants, LLC. He has fifteen years of professional experience in Autodesk products and civil design. His project design experience ranges from small residential subdivisions to large commercial and industrial site development, including natural gas well pads/pipelines and landfill design. Steve has over 8 years of experience in Civil 3D, is AutoCAD and AutoCAD Civil 3D Certified Professional, and Autodesk Civil Infrastructure Gunslinger. With knowledge in AutoLISP, .NET, and SQL programming, Steve strives to redefine and improve the day to day workflows in the software. He currently has about 20 apps available on the Autodesk App Store, primarily focused on Civil 3D. He is also involved in beta testing AutoCAD, Civil 3D, and InfraWorks software.

A Brief History of Time with Autodesk Civil Engineering Software – Underground Utilities Edition

DCA → Softdesk → Land Development Desktop →AutoCAD Civil 3D → InfraWorks
The following timeline is a brief summary of the history of development of Autodesk's underground utility modeling software packages for civil engineering.

Late 1980's	David C Arnold (DCA) Engineering released a pack of AutoCAD LISP routines for Civil Engineers
1994	DCA Softdesk released for AutoCAD R13
1997	DCA Softdesk released for AutoCAD R14. By this time the Pipeworks engine was flushed out in the software, including many of the same pipe network abilities in Civil 3D today. Pipeworks also included ability to design with hydraulic data (flow rate and velocity).
1998	Autodesk acquired Softdesk, and Land Development Desktop (LDD) was born (later just LD).
2003	Civil 3D was introduced as a preview software. Pipe Networks were not present in the software. Civil 3D was still intended to be ran in conjunction with LD for gravity pipe design.
2005	Civil 3D 2006 was released. Pipe Network functionality is introduced for the first time. This included customizable external catalogs; dynamic updates between plan, profiles, and sections; Pipe Rules for initial layout; Import and Export Land XML files; and more.
2006	Civil 3D 2007 was released. Some of the highlights include interference checks, create alignment from network parts, modifying and applying rules to existing pipe network, export to Spatial Data Format (.sdf) for GIS, pipe bands in profile views, and the beloved Part Builder!
2007	Civil 3D 2008 was released. The highlights included spanning pipe labels in plan view and dynamic pipe and structure tables.
2008	Autodesk acquired Intelisolve, creator of the Hydraflow software package. Soon after Civil 3D 2008 received an update for subscription customers for the standalone installation of Hydraflow Hydrographs, Storm Sewers, and Express.
	Civil 3D 2009 was released. New abilities included spanning pipe labels for profile views, rename/renumber multiple parts and structures at once, graphical enhancements for pipe-to-pipe connections, and improved sharing and access to part catalog libraries. Hydraflow software installed along with Civil 3D 2009.
2009	Autodesk acquires the assets of BOSS International: StormNET, RiverCAD, and WaterNET. StormNET would later become Storm and Sanitary Analysis (SSA) and RiverCAD would become the River & Flood Analysis Module for Civil 3D. WaterNET is still M.I.A.
	Civil 3D 2010 was released. The Hydraflow Storm Sewers (HSS) .stm file could now transfer data directly back and forth between Civil 3D and HSS. HGL and EGL parameters were added to pipe networks, and the value could be transferred in from the HSS .stm file after analysis. Some new out-of-the-box content was also delivered for the part catalog such as CMP, HDPE pipe, and several endwalls.
2010	Civil 3D 2011 was introduced. Not much was updated except the ability to split or merge networks and the ability to select the vertex elevation when creating pipe networks for

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	objects. The "Outside Top" vertex option did provide for a slightly better way to model water piping using the Pipe Network functionality.
2011	Autodesk Infrastructure Modeler (AIM) 2012 was announced. In its early state it provided very little design capability and was mostly used as a planning tool to bring in a vast array of GIS file formats for visualizing in 3D.
	AutoCAD Utility Design (AUD) 2012 was announced along with AIM. AUD would provide a BIM platform for electrical distribution systems, integrating a rules engine into the AutoCAD Map 3D environment. To date this software delivers one of the most robust 4D and 5D modeling environments of any infrastructure design software.
	Civil 3D 2012 was released with an enhanced focus on hydrology and hydraulics improvements. SSA installed alongside Civil 3D, and part migration settings were added to enhance data transfer between Civil 3D, SSA, and HSS. Pipe networks could be created from imported GIS data, structures received an "inlet location" parameter for on-sag or on-grade, and the Catchment object was introduced that provided the ability to delineate a watershed and link it to a storm structure before exporting to SSA or HSS for analysis.
2012	Civil 3D 2013 was released. Perhaps the biggest new feature in the entire release was the addition of Pressure Networks, a purpose built system for designing water distribution systems. Unfortunately it suffered from some bugs and it contained limited functionality (no section views, no crossing pipe style, no Data Shortcuts, etc.). Content Catalog Editor was included with the Civil 3D installation that provided a way to create and manage Pressure Network catalogs, however the out-of-the-box content was very limited.
2013	Civil 3D 2014 was released with several enhancement for Pressure Networks that made using the new tools a viable alternative for water systems layout. Some of these enhancements included slide and move functionality for multiple parts editing, 3D plane compass for using during layout and editing of Pressure Networks in model view, Pressure parts in section view, crossing pipe styles for Pressure parts in profile view, sorting of Pressure parts lists, Pressure Network Data Shortcuts, and Dynamic Pressure Network tables.
	InfraWorks 360 releases this year with pipelines and pipe connectors. This provides the ability to aggregate GIS utility information.
2014	Civil 3D 2015 was released. Vault support was added for Pressure Networks, and sliced solids option was added for Pipe Network parts in section views.
	InfraWorks 360 releases three updates during 2014, including the introduction of Drainage Design for culvert design (April), and pavement drainage in the December timeframe. InfraWorks 360 2015.3 and the Civil 3D 2015 Productivity Pack introduce a shared workflow for drainage networks.
	Project Kameleon was launched in late 2014 on Autodesk Labs. This new software sought to provide a method for authoring infrastructure utilities content for multiple software packages in a single environment, with the main focus being on part authoring for InfraWorks that could be translated to the existing part paradigm in Civil 3D. Finally a potential replacement for Part Builder!

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	Civil 3D 2015 received a Productivity Pack that included the new Generic Drainage Catalog, which enabled the transfer of drainage network content between Civil 3D and InfraWorks.
2015	InfraWorks 360 releases in April that includes a sizing function for pavement drainage. In-place inlet analysis occurs automatically, and the Inspect Performance command allows the viewing the hydraulic and energy gradeline for a stretch of the network. The June release of Drainage Design supports component roads for placement, and spread analysis and the automated determination of the runoff coefficient per tributary area.
	Civil 3D 2016 was released with minor utilities updates. Pressure parts could be labeled in section views, crossing pipe labels were introduced for Pipe and Pressure Networks in profile and section view, and the Generic Drainage Catalog was included with the install to allow transfer of drainage network models between Civil 3D and InfraWorks.

Some Questions to Ponder Prior to AU 2015

This roundtable discussion will focus on lessons learned in the Autodesk history of underground utility infrastructure, how we build on those lessons learned, and what ideas we might have for future improvements. Prior to attending the roundtable discussion please consider the following questions. It is recommended that you write down your thoughts on each, as recalling them during the hectic environment of AU could prove to be difficult and we must stay focused during these discussions to get through all of our questions in the allotted time. It would also be beneficial to the product development team if you would provide your written feedback to these questions; if you would like to participate please bring an extra copy with you to leave with the Speakers.

1. What has worked well or has proven to be the most valuable tool in the history of Autodesk software underground utility infrastructure design?

2. What has proven to be one of the most difficult problems to over overcome in your history working with the software (does not have to be in the current versions, it could be a challenge that has since been overcome with new updates)?

3. What has been your biggest challenges designing, analyzing, and/or revising designs in your day-to-day projects? This is not limited to working in software, but all aspects of the project.

4. What types of underground utilities have you created models for? These might include but are not limited to:

    a. Wet – Gravity
        i.   Storm
        ii. Sanitary
    b. Wet – Pressure/Force Main
        i.   Potable Water
        ii.   Reclaimed Water
        iii. Sanitary
        iv.   Storm
        v.   Gas
        vi.   Steam
        vii. Fuel / Oil
    c. Dry
        i.   Electrical conduits and duct banks
        ii. Data/Comms conduits and ducts

5. Can you think of some examples of the type of information (the "I" in BIM) that you would like to hold within the design model for these types of utilities?

6. What types of engineering analysis would you expect your ideal Civil Infrastructure BIM software to be capable of running on the fly as edits are made or with the single click of a button?

7. How might the industry engage civil infrastructure manufacturers (think precast concrete, iron storm grates, water valves and backflow preventers) and get them to produce content for designers and engineers, similar to the way Revit Families are provided by vertical building product manufacturers?

8. Civil Engineers… Are you willing to provide a BIM model for a contractor to work from? Contractors… Are you willing to use the BIM model for utility construction if it were available to you?

9. What is your opinion of the current status of underground utilities in Civil 3D and InfraWorks? What would you like to see prioritized by the software development teams?