STEP UP YOUR GAME – PLANT & INFORMATION DESIGN (P&ID) IN A MULTI-DISCIPLINE DESIGN

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PD6544-R - In this class we will discuss the use of intelligent and informative design applications and 3D Building Information Modeling (BIM) in a multi-discipline project environment. These methods enable the rapid creation of project reports, bills of material, and additional supporting project documentation for both design review and procurement support. Discussion topics include the collaboration capabilities and conflicts between AutoCAD P&ID software, AutoCAD Plant 3D software, Revit software, AutoCAD Civil 3D software, and Navisworks project review software. We will also cover referencing models from various design software, export and import methods, and real-time design review. These capabilities are not only beneficial to engineers and designers, but they also provide substantial benefit to the client, the contractors and the construction managers. We will look at the limitations and advantages to working in a multi-discipline, real-time environment, and we will touch on some of the most effective practices and work-arounds.

Learning Objectives

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

- Discover the most effective practices and approaches to a multi-discipline BIM environment
- Use Autodesk design programs to create a multi-discipline BIM environment
- Implement efficient practices and workflows when working in a BIM environment
- Recognize the limitations and advantages of a multi-discipline BIM environment

About the Speaker

Julian Chavez is an engineering designer providing Intelligent-Design Solutions and other support within the Colorado offices of URS Corporation. Julian supports real-time design using AutoCAD Design Suites software for multiple practices, including oil and gas and mining process engineering, civil works, and structural. Julian is an AutoCAD Certified Professional with more than 15 years of experience. His vast knowledge has enabled him to provide training and support within his field for the past 5 years. Julian's approach to teaching and public speaking creates a comfortable and productive learning environment. He has presented to clients and peers from numerous disciplines, ranging from groups of five people to those including 80 people.
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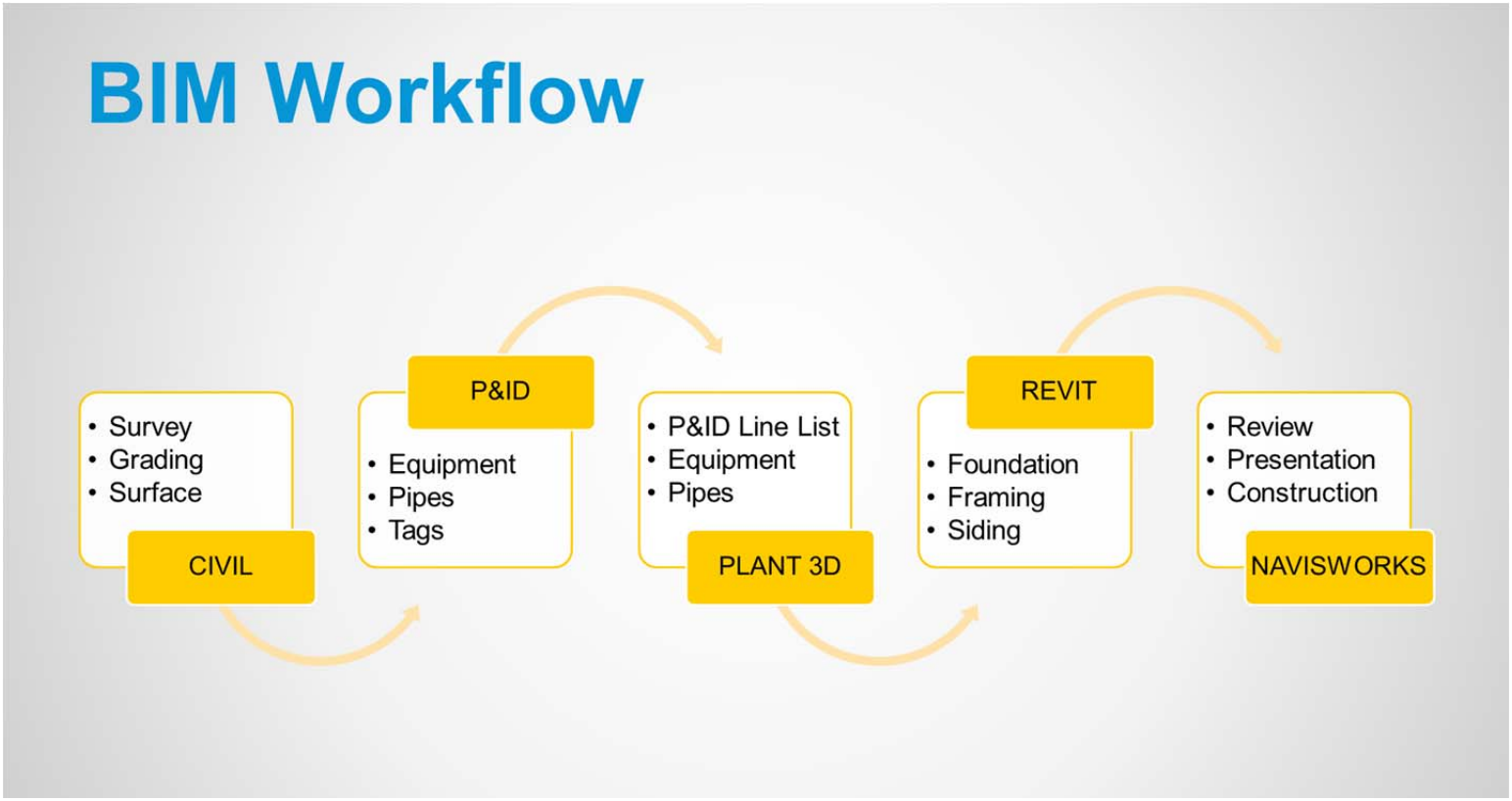

Figure 1 – BIM Workflow

Introduction

When working on a multi-discipline BIM project, there is a process and series of procedures that should be followed. When a project is executed in an orderly, planned way, the results will be more consistent and reliable. In this session, we will discuss the processes and procedures that should take place to ensure a successful multi-discipline project. You will learn what to expect in a multi-discipline project and how to move forward through each discipline.

Survey

When beginning a BIM project, one of the first elements received should be existing survey data. The survey data in this case is going to be the foundation of the project and what acts as its base. Survey can be received in a variety of forms from points to contours. In this instance, contours for the existing survey were received, and a surface was then created from those contours (**Figure 2**).

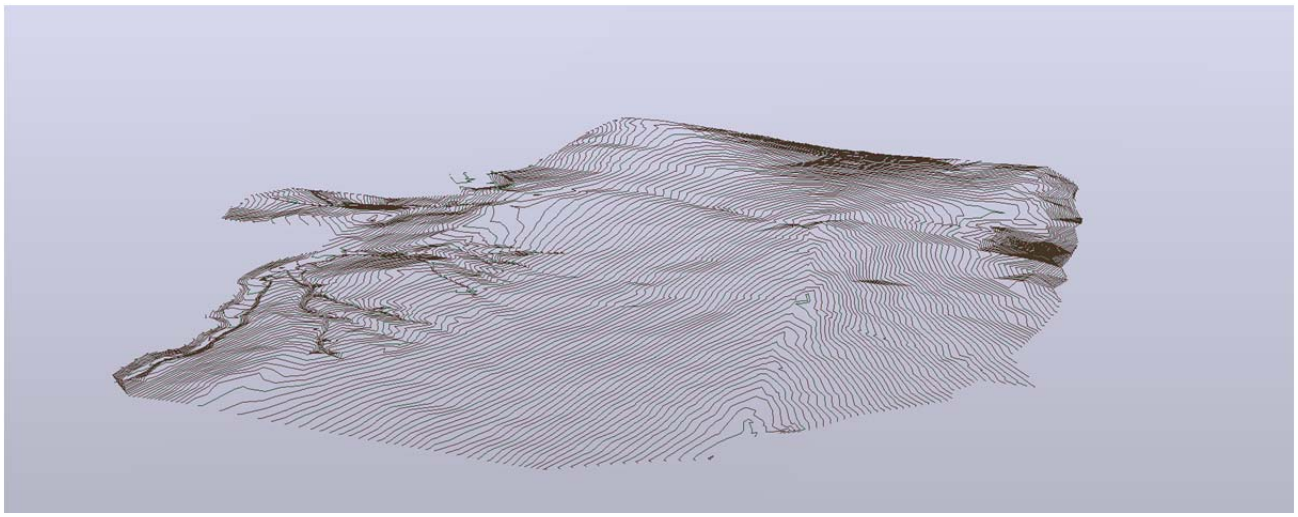

Figure 2 – Existing Ground Surface Based off Survey

Civil

Once the existing surface based off survey data is created, it is time for the Civil design aspect of the project to be incorporated. This portion will be ever changing like a lot of the disciplines discussed from this point on. Coordination is key amongst the various disciplines collaborating on the project, as the design decisions of the project will affect the proposed surface. Now is the time to plan the layout and verify the placement and positioning of buildings, major equipment, and pipe routing. Knowing the layout and functions of equipment will assist in grading, especially when it comes to gravity systems, pipe depths and cover, duct banks, and routing between points A and B. This establishes the proposed ground surface (**Figure 3**).

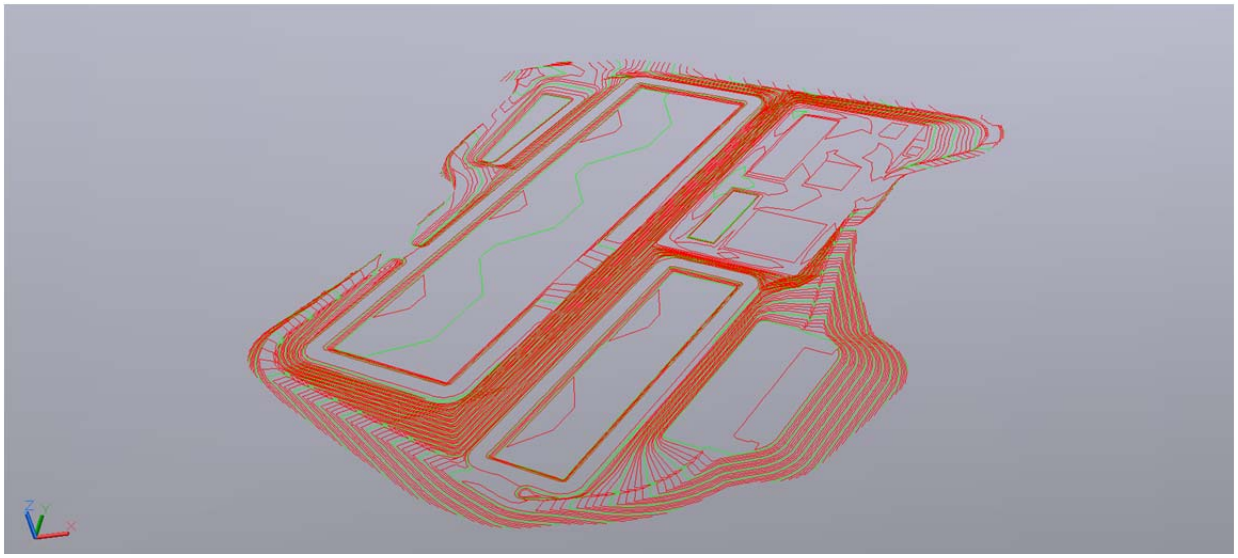

Figure 3 – Proposed Ground Surface

Now that there is a proposed surface in place, it's time to add the visual 3D element, which comes in the form of thickness. Decide a depth to extrude the faces of the survey using a predefined path and then combine them together (**Figure 4**).

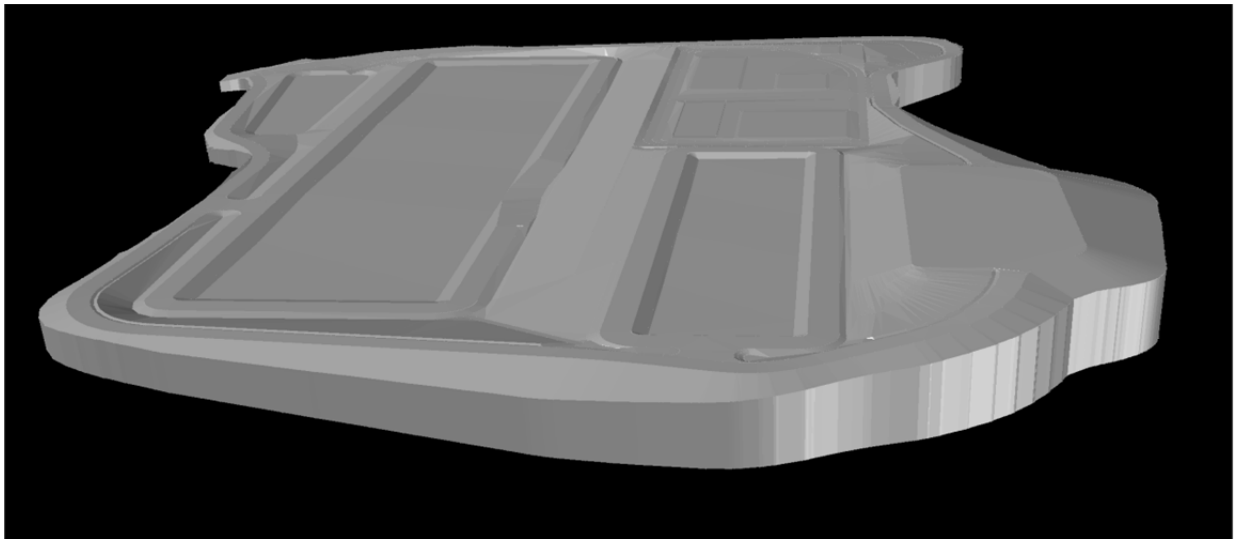

Figure 4 – 3D Proposed Surface

Once these steps have been followed, a survey converted to 3D solid will be created that can be saved as a block and referenced in the drawings.

Project Setup

Project Setup is key and can be detrimental to a project if done incorrectly. When a project is first created, it's a good idea to set up project location/units/folder structure, etc. so that it's easily accessible to the team.

During the Project Setup, there will be a window (**Figure 5**) asking if a SQL Express server database will be established or if you would like to open a SQLite database. SQLite works well to manage data for smaller projects with only a few users, but it does not handle large projects with multiple users very well. These large project limitations stem from the fact the SQLite is an embedded, server-less database that simply reads and writes directly to hard disk files, when there are eight users working on a SQLite project, it's inevitable that users will be trying to write to the database simultaneously, which can result in errors. It is highly recommended to create a SQL Express server database rather than the SQLite option. The benefits of SQL Express are that you or a project administrator may give or restrict access to the project as well as link to data sheets or reports within the Plant Design Suite software or 3rd party programs such as Instrument Manager.

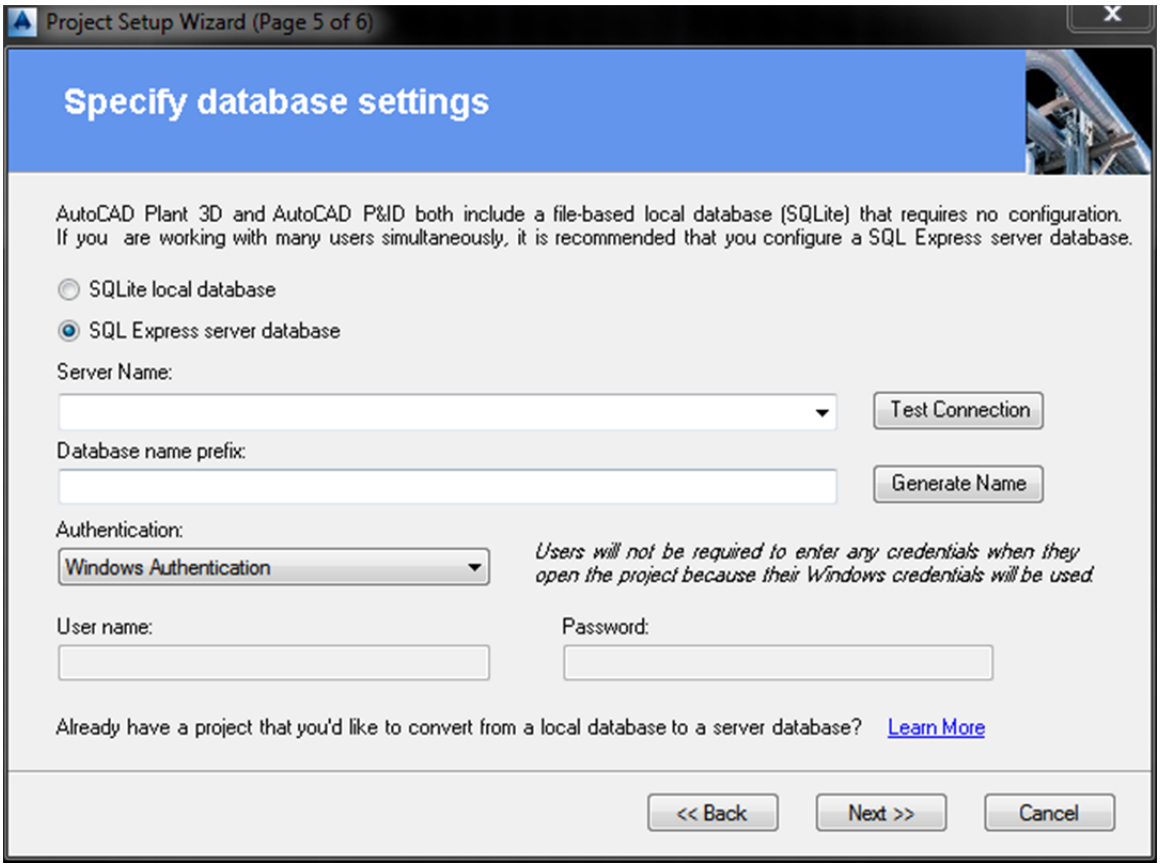

Figure 5 – SQL Express is a Highly Recommended Setting in Project Setup

This single toggle that you see in **Figure 6** is the most important toggle of the Setup Wizard. It allows additional project settings to be edited after creating a project. If settings are copied from a previous project that contains all of the information needed, do not check that box. It will inhibit anyone from changing additional information within the project setup, including editing property fields and adding or modifying tags and equipment. It is recommend that this box be checked in order to continue editing, adding, and building out each project so that the library (project.xml) continues to grow.

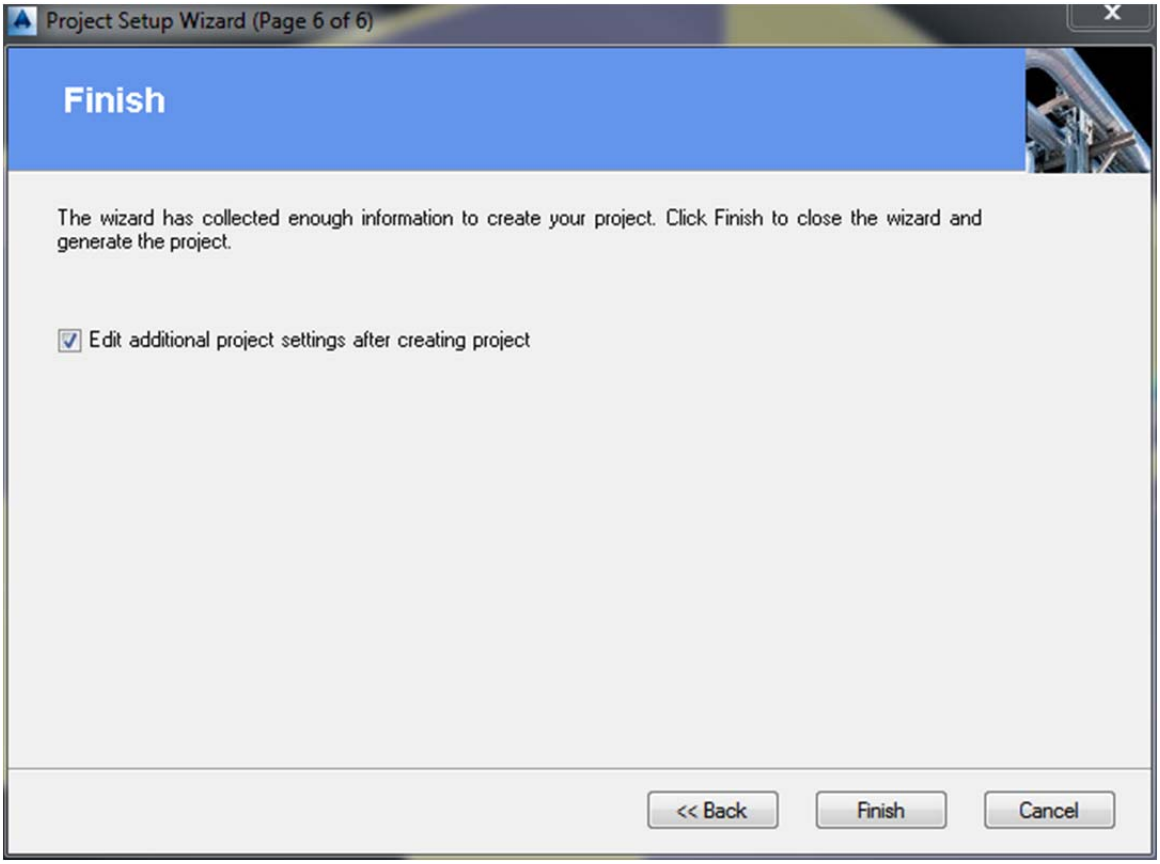

Figure 6 – Checking This Box is Highly Recommended to Continue Growing the Project Library (project.xml)

If the “Edit additional settings after creating project” is checked, the window below will open to the general settings tab in the project setup. **Figure 7** shows the next level within the hierarchy of project settings. Under P&ID Class Definitions/Engineering Items, symbols, properties, and annotation can be added, edited, or removed. Ensuring that all information is contained in the P&IDs will assist with the creation and development of the model. This portion may be behind the scenes, but if blocks, symbols, tags, equipment and more need to be edited, modified, or created this is the place to do it. Project Setup is a one way highway from your P&IDs to your 3D Model, so make sure everything is covered in the Project Setup so that the flow of information can remain seamless through the P&IDs to the 3D Model.

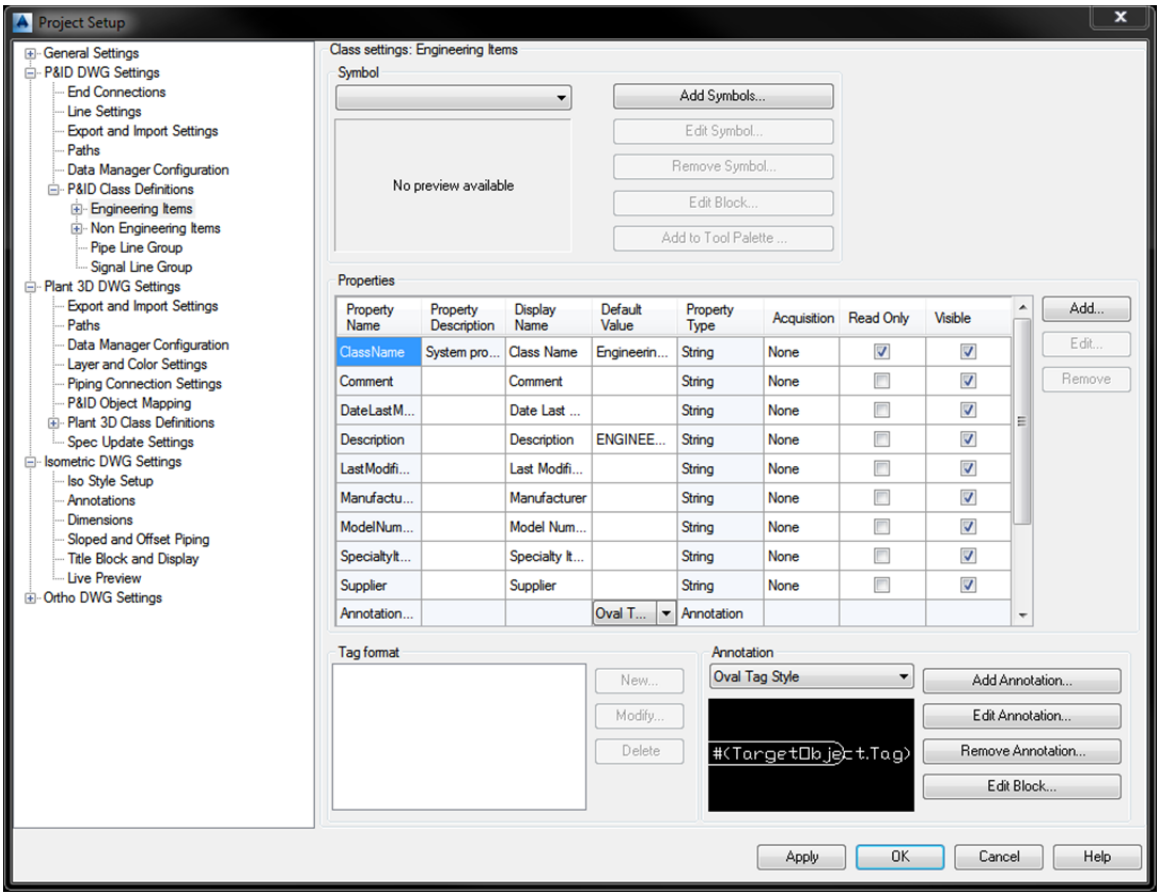

Figure 7 – Project Setup Manager Tree View - Edit and Add Components within the Project

P&ID

As the Survey is being taken and the Civil is being setup, the P&IDs should be well on their way to complete. Try to aim for 60% minimum. This may seem unrealistic due to typical workflows, but now is the time to establish and enforce new workflows. The facilities process is usually known and, in some cases, well thought out before the location is ever chosen. This means having all major equipment, piping, and instrumentation at a 60% level of completion on the P&IDs so that when the piping and equipment model is being created, the P&IDs can serve as a blue print and allow for tag association while placing the 3D element.

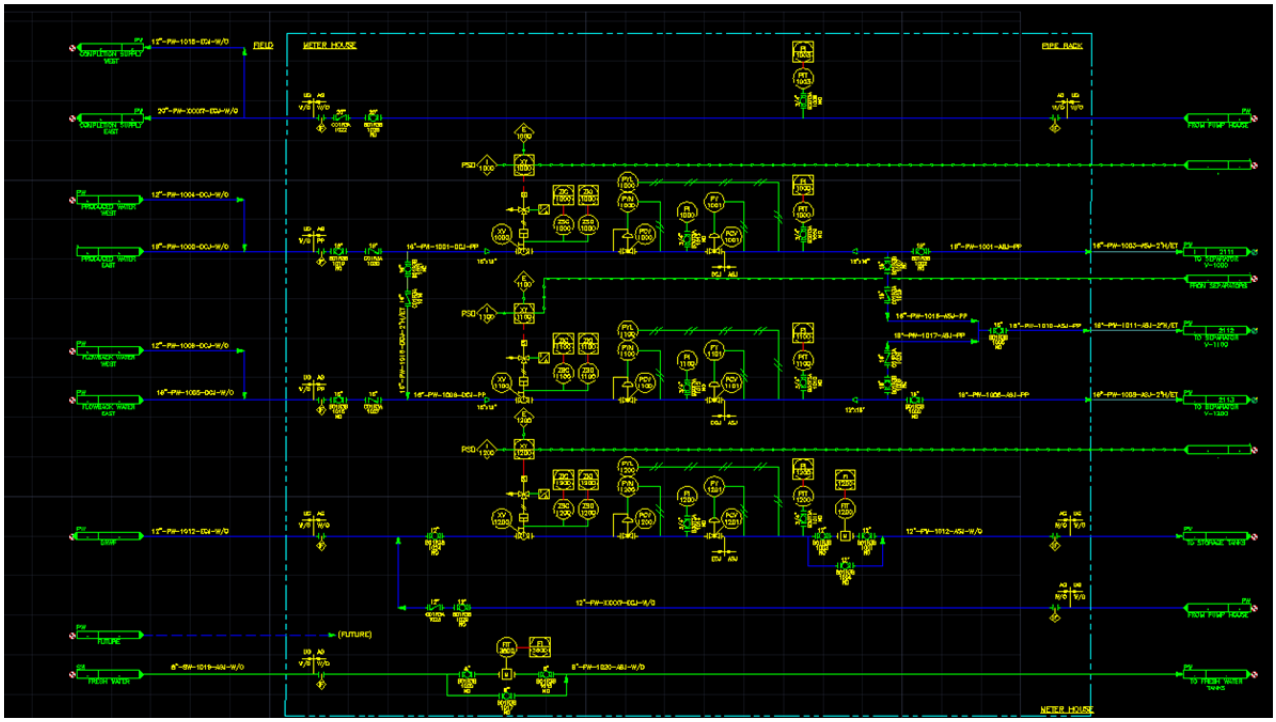

Figure 8 - 60% Complete P&ID Drawing

Model

Once the model work is started, it is wise to make sure that your P&IDs are being used as a guideline or a blueprint. Take the time to use the P&ID line list shown in **Figure 9** when placing pipes and equipment; this will carry over the tagging and specification information from the P&IDs to the Model.

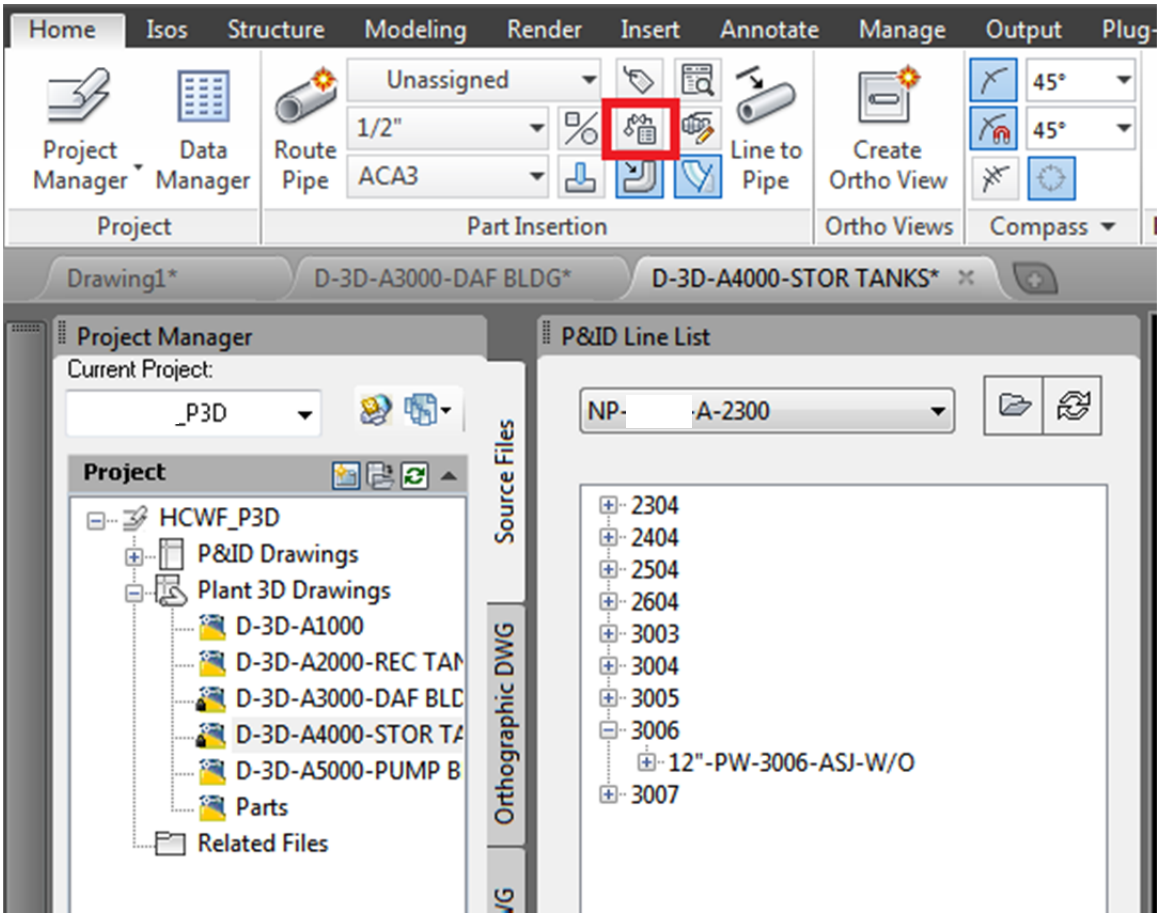

Figure 9 – Toggle for P&ID Line List within 3D Modeling Workspace

When placing equipment the lay lengths and layout must be taken into consideration. Try to keep the pipes at whole numbers, include spools for accessibility, space for equipment, and instrumentation. When laying out the equipment it is best to know if it will be placed in a building and what the accessibility requirements are so that the proper clearances are accounted for.

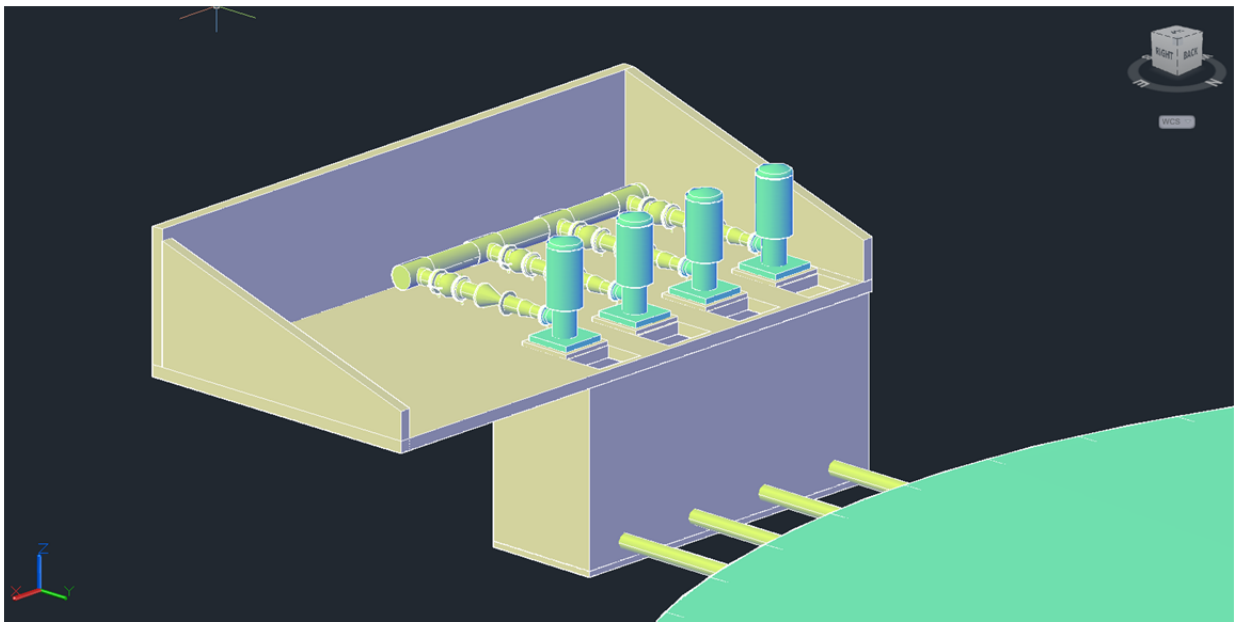

Figure 10 – 3D Pump Station Representation of Layout and Clearance

Revit

One of the last disciplines to be incorporated will be Structural. Building locations will most likely be set based off of the grading, pipe routes, and equipment locations. Once it has been determined what needs to be housed within a building, the structural portion can begin.

Foundations and Framing will be established where buildings are placed. The next step considers preliminary sizes of the buildings and designing for the footings based off of loads. Remember to account for clearance, access, and operations and maintenance requirements. Structural components such as gangways, platforms, railings, and ladders should also be considered as they can affect the width and height of your building.

Pre-Engineered Metal Building (PEMB) is a go to when designing structures for these types of projects. Manufacturers of the PEMB can provide all the information needed in order to design for the loads. This approach is recommended so that the structural engineer doesn't have to design every single building within the project.

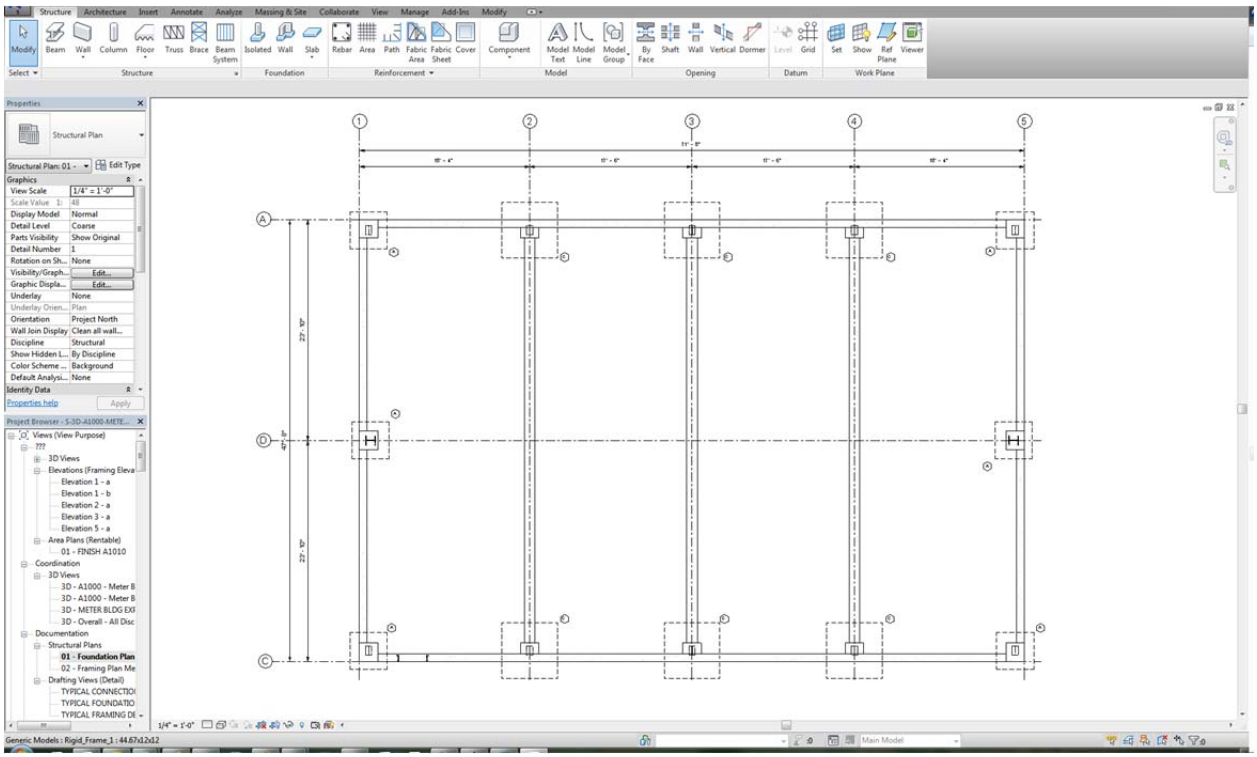

Figure 11 – Foundation and Framing within Revit

Conversion

When working in various units, such as architectural and decimal, it is important to take into account the conversions. All work within Civil 3D will be in decimal units including the survey and existing and proposed grading. Even the 3D extruded surface will be in decimal units. The Plant 3D Model with piping and equipment as well as the Revit structural models will be in architectural units. In order to successfully convert all model types, it is necessary to decide on an origin point. From this point, scale down the Plant 3D and Revit models by a factor of 12. Next, determine a rotation from true North so that the models will align with the site. Once you have completed the scaling and rotation it should look similar to **Figure 12**.

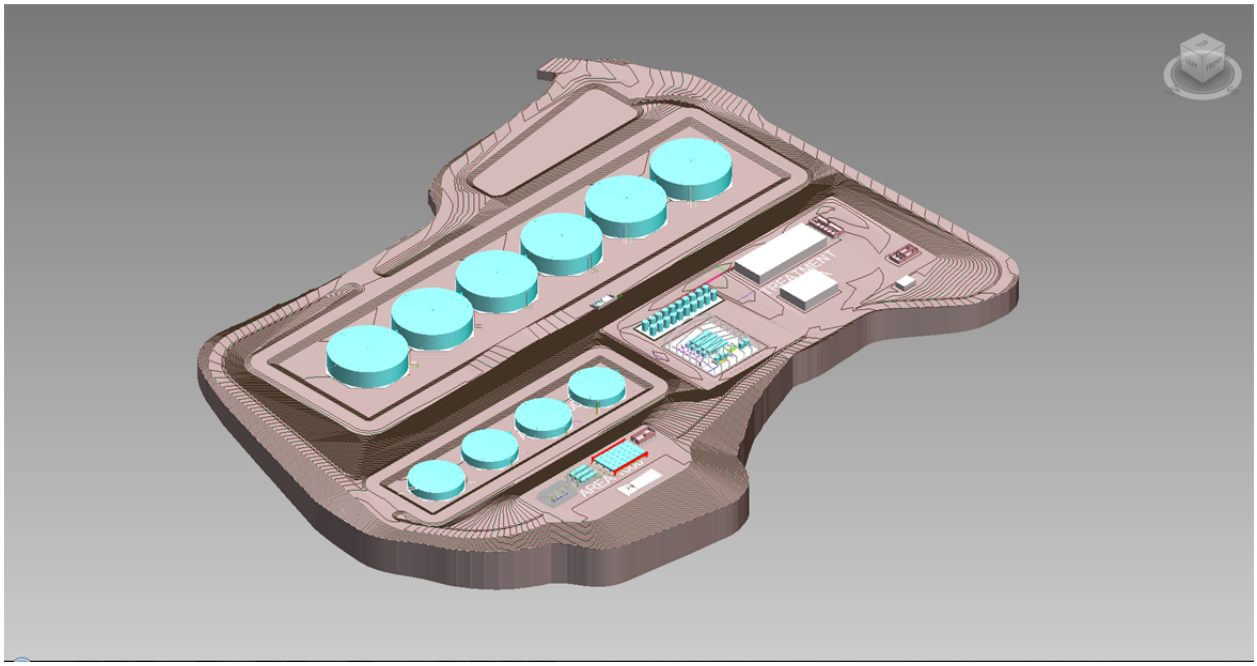

Figure 12 – 3D Model Containing Civil, Plant/Process and Structural Elements

Navisworks

After all of the models have been referenced and the conversions completed, it is time for clash detection and walkthroughs. Navisworks allows for the opening and importing or many file extensions so it works well with other programs in Autodesk's portfolio. Once the model has been opened, along the ribbon there will be options for clash detection, walkthroughs, animation, output, and more. By using these tools in the ribbon the review process becomes easier. A group review can now take place while questions and concerns are discussed or addressed using the model. Showing the client current progress or milestones on the project creates a more in depth feel by creating a 3D export or PDF. My favorite of the tools is shown in **Figure 13** under output in the Export Scene section. Using 3Ds Max, you can show a selection committee member or town hall gathering what the project looks like on Google Earth. By embracing and utilizing these tools within Navisworks we can even assist contractors in the construction by being able to visualize the project in 3D.

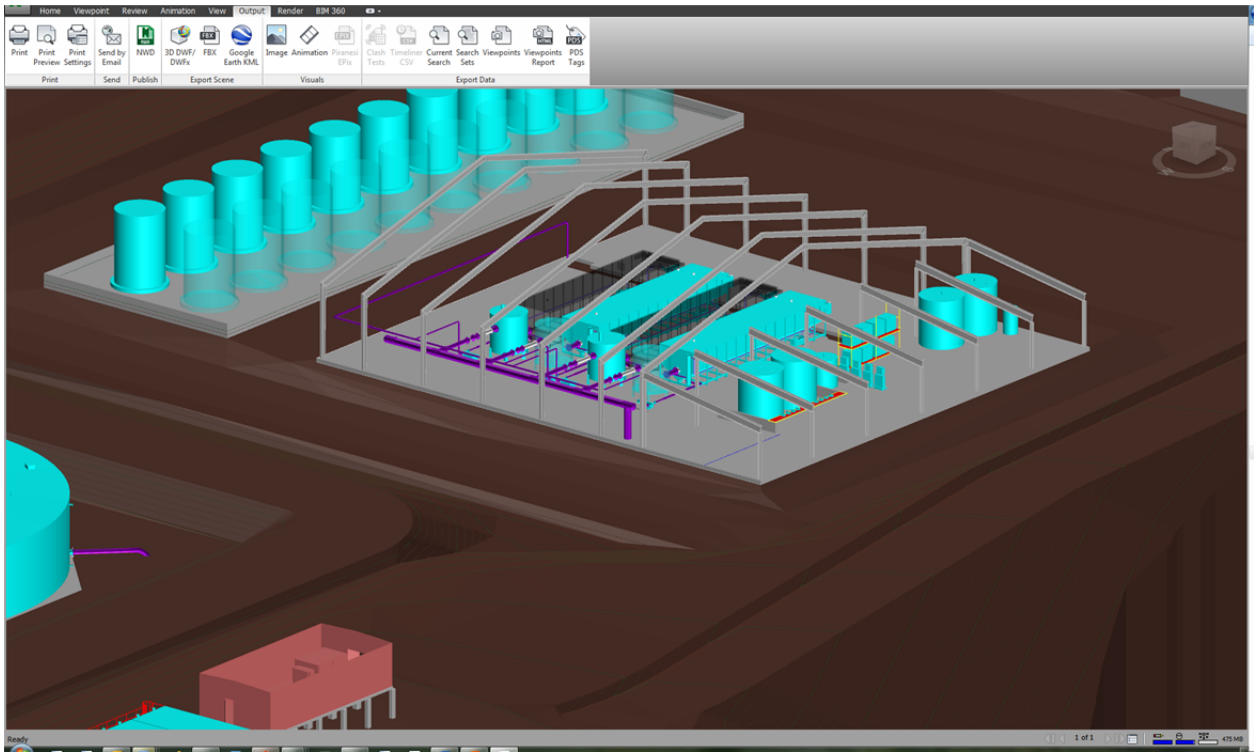

Figure 13 – Navisworks Output Tab on Ribbon Viewing Process within Building

Benefits

- BIM (Building an Intelligent Model)
- Centralizes All Project Data
- Client Relationship Strengthened
- Group/Peer Model Reviews
- Equipment and Instrumentation Review Time Reduced
- Bill Of Materials
- Conflicts Found and Addressed Early
- Lowers Cost in Revisions
- Reduces Change Orders