Beginner

Introduction to Plant Design 2022

Imperial

Sample provided by ASCENT for review only
All copying and reuse strictly forbidden.

December 2021

AUTODESK
Authorized Publisher

© 2021 Autodesk, Inc. All rights reserved.

Except as otherwise permitted by Autodesk, Inc., this publication, or parts thereof, may not be reproduced in any form, by any method, for any purpose.

Certain materials included in this publication are reprinted with the permission of the copyright holder.

Trademarks

The following are registered trademarks or trademarks of Autodesk, Inc., and/or its subsidiaries and/or affiliates in the USA and other countries: 123D, 3ds Max, Alias, ATC, AutoCAD LT, AutoCAD, Autodesk, the Autodesk logo, Autodesk 123D, Autodesk Homestyler, Autodesk Inventor, Autodesk MapGuide, Autodesk Streamline, AutoLISP, AutoSketch, AutoSnap, AutoTrack, Backburner, Backdraft, Beast, BIM 360, Burn, Buzzsaw, CADmep, CAiCE, CAMduct, Civil 3D, Combustion, Communication Specification, Configurator 360, Constructware, Content Explorer, Creative Bridge, Dancing Baby (image), DesignCenter, DesignKids, DesignStudio, Discreet, DWF, DWG, DWG (design/logo), DWG Extreme, DWG TrueConvert, DWG TrueView, DWGX, DXF, Ecotect, Ember, ESTmep, FABmep, Face Robot, FBX, Fempro, Fire, Flame, Flare, Flint, ForceEffect, FormIt 360, Freewheel, Fusion 360, Glue, Green Building Studio, Heidi, Homestyler, HumanIK, i-drop, ImageModeler, Incinerator, Inferno, InfraWorks, Instructables, Instructables (stylized robot design/logo), Inventor, Inventor HSM, Inventor LT, Lustre, Maya, Maya LT, MIMI, Mockup 360, Moldflow Plastics Advisers, Moldflow Plastics Insight, Moldflow, Moondust, MotionBuilder, Movimento, MPA (design/logo), MPA, MPI (design/logo), MPX (design/logo), MPX, Mudbox, Navisworks, ObjectARX, ObjectDBX, Opticore, P9, Pier 9, Pixlr, Pixlr-o-matic, Productstream, Publisher 360, RasterDWG, RealDWG, ReCap, ReCap 360, Remote, Revit LT, Revit, RiverCAD, Robot, Scaleform, Showcase, Showcase 360, SketchBook, Smoke, Socialcam, Softimage, Spark & Design, Spark Logo, Sparks, SteeringWheels, Stitcher, Stone, StormNET, TinkerBox, Tinkercad, Tinkerplay, ToolClip, Topobase, Toxik, TrustedDWG, T-Splines, ViewCube, Visual LISP, Visual, VRED, Wire, Wiretap, WiretapCentral, XSI.

NASTRAN is a registered trademark of the National Aeronautics Space Administration.

All other brand names, product names, or trademarks belong to their respective holders.

Disclaimer

THIS PUBLICATION AND THE INFORMATION CONTAINED HEREIN IS MADE AVAILABLE BY AUTODESK, INC. “AS IS.” AUTODESK, INC. DISCLAIMS ALL WARRANTIES, EITHER EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE REGARDING THESE MATERIALS.

Published by:

ASCENT Center for Technical Knowledge
630 Peter Jefferson Parkway, Suite 175
Charlottesville, VA 22911
866-527-2368
www.ascented.com

Sample provided by ASCENT for review only
All copying and use strictly prohibited

Contents

Exercise Files ..... **iii**

Chapter 1: Introduction to AutoCAD Plant 3D **1**

Lesson: Working in a Project **2**
Exercise: Work in a Project 13
Lesson: Opening a Drawing **18**
Exercise: Open a Drawing in AutoCAD Plant 3D 22
Lesson: Exploring the User Interface **24**
Exercise: Explore the User Interface 32
Lesson: Managing Layers and Colors **36**
Exercise: Manage Layers and Colors 39

Chapter 2: AutoCAD P&ID **45**

Lesson: Creating and Adding Existing Drawings **47**
Exercise: Create a New P&ID Drawing 52
Lesson: Equipment and Nozzles **55**
Exercise: Equipment and Nozzles 61
Lesson: Piping **68**
Exercise: Place Lines and Inline Components 75
Lesson: Instruments and Instrument Lines **83**
Exercise: Instruments and Instrument Lines 88
Lesson: Tagging Concepts **93**
Exercise: Add a Tag and Link Multiple Symbols to a Tag 97
Lesson: Annotation Concepts **100**
Exercise: Annotate Your P&ID 104
Lesson: Editing Techniques **108**
Exercise: Modify the Layout of Your P&ID 116
Lesson: Data Manager and Reports **122**
Exercise: Use Data Manager to Review, Export, and Import Data 129
Lesson: Custom One-off Symbols **134**
Exercise: Customize One-off Symbols 137
Lesson: Offpage Connections **140**
Exercise: Add and Leverage Offpage Connectors 146
Lesson: Generating Reports **153**
Exercise: Generate Reports 157

Chapter 3: AutoCAD Plant 3D - Imperial **161**

Lesson: Creating Project Folders and Drawings **162**
Exercise: Create Project Folders and Drawings 167

Sample provided by ASCENT for review only
All content is strictly forbidden.

Lesson: Steel Modeling and Editing **170**
Exercise: Build a Steel Structure 176
Lesson: Equipment Modeling and Editing **186**
Exercise: Create Equipment 190
Exercise: Convert Equipment and Attach AutoCAD Objects 198
Lesson: Piping Basics **202**
Exercise: Route Pipe and Add Fittings, Branch Connections, and Pipe Supports 207
Lesson: Piping Editing and Advanced Topics **221**
Exercise: Modify and Reuse Data 230
Lesson: Working with P&ID Data in Plant 3D **241**
Exercise: Add and Validate Pipelines Using the P&ID Line List 251
Lesson: Creating and Annotating Orthographic Views **259**
Exercise: Create and Annotate Orthographic Views 268
Lesson: Creating Isometric Drawings **279**
Exercise: Create Isometric Drawings 285

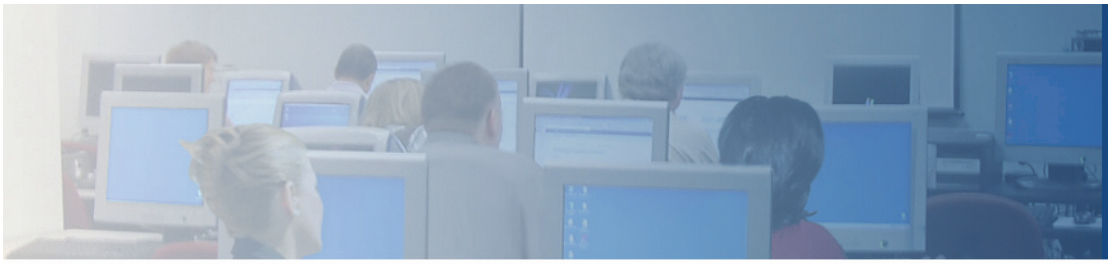
Chapter 4: Autodesk Navisworks **293**

Lesson: File Handling **294**
Exercise: Work with Autodesk Navisworks Files 299
Lesson: Basic Navigation and Walkthroughs **302**
Exercise: Navigate Your Way Through a Design 311
Lesson: Clash Detection **319**
Exercise: Conduct Clash Tests 323
Lesson: Highlights of Scheduling and Rendering **327**
Exercise: Working with the Fourth Dimension 331

Chapter 5: Setting Up and Administering a Plant Project **339**

Lesson: Overview of Project Setup **340**
Exercise: Set Up and Structure Your Project 347
Lesson: Overview of Project Structure and Files **355**
Exercise: Manage Your Project 361
Lesson: Setting Up Larger Projects **366**
Exercise: Optimizing a Project for Multiple Users 373
Lesson: Defining New Objects and Properties **381**
Exercise: Create Symbols and Set Up the Tagging Scheme 394
Lesson: Customizing Data Manager **409**
Exercise: Create Views and Manage Reports 417
Lesson: Creating and Editing Drawing Templates and Data Attributes **428**
Exercise: Create a Template for AutoCAD Plant 3D 432
Lesson: Specs and Catalogs **440**
Exercise: Configure Specs and Catalogs 445
Lesson: Isometric Setup **462**
Exercise: Create a Custom Isometric Drawing Setup 474
Lesson: Troubleshooting **482**
Exercise: Troubleshooting 489
Lesson: Creating and Managing Report Configurations **494**
Exercise: Create and Manage Report Configuration Files 508
Lesson: Setting Up SQL Server for AutoCAD Plant 3D **518**

Sample provided by ASCENT for review only
All copying and reuse strictly forbidden.



Chapter

1

Introduction to AutoCAD Plant 3D

The plant design industry creates and communicates a vast array of information. Because the industry consists of many facets of design, the industry requires a broad solution. AutoCAD® Plant 3D and Autodesk® Navisworks® are two separate software applications that work together to meet the requirements of a broad solution. In this chapter, you learn about many of the general topics for plant design and the use of the AutoCAD Plant 3D software to create plant designs that meet your design requirements and workflows.

Objectives

After completing this chapter, you will be able to:

- Navigate the Project Manager and explain the purpose of a project and where the drawings and data are stored.
- Open drawings in the context of the project from the Project Manager.
- Identify the aspects of the user interface that are unique for plant design and the workflow for creating and modifying a P&ID or 3D plant design.
- Explain the philosophy behind layering and explain the project setup options for layers and colors.

Sample provided by ASCENT for review only
All copying and reuse strictly forbidden.

Lesson: Working in a Project

Overview

This lesson describes how to navigate the Project Manager, the purpose of a project, and where the data and drawings for a project are stored.

Because a complete plant design project can be composed of many different drawing files, it is important to be able to efficiently access and create the files while keeping them associated with the project. The Project Manager is the central hub where you access all of the drawings. Along with providing easy navigation to the various drawings, you can also use the Project Manager to set up drawings, establish common project settings, import and export data, and create project reports.

Objectives

After completing this lesson, you will be able to:

- Describe how AutoCAD P&ID and AutoCAD Plant 3D projects work with data.
- Explain how data is organized in the AutoCAD Plant 3D software.
- Describe the Project Manager user interface.
- Explain the purpose of the Data Manager.

Sample provided by ASCENT for review only
All copying and reuse strictly forbidden.

About Projects

A project in the AutoCAD P&ID software or the AutoCAD Plant 3D software is made up of a collection of drawings and other forms of data. When collected together, these data sources interact in the larger context of a project. When you work with any individual component of the project, such as orthographic or isometric drawings, you do so from in the project rather than by directly opening these drawings from outside the project. This approach maintains the integrity of the relationships between the components in the larger project. One of the primary reasons to use the AutoCAD P&ID software or the AutoCAD Plant 3D software instead of the AutoCAD software is that the AutoCAD P&ID software and the AutoCAD Plant 3D software create not just a simple drawing but data associated with drawings and the items in them.

Project Components

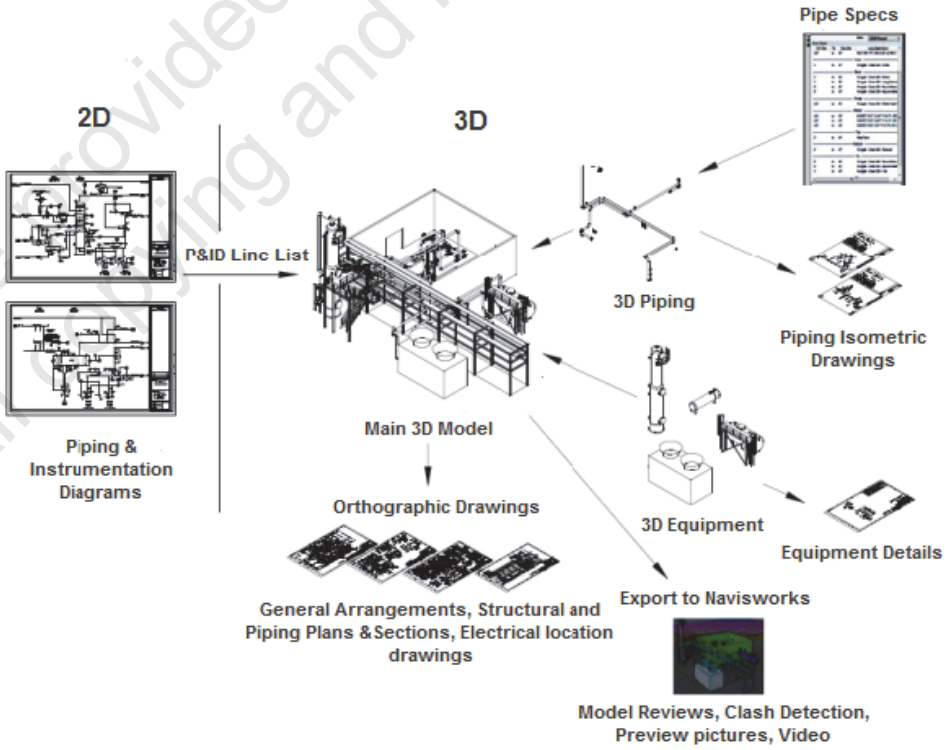
Some of the drawings that are used as components of a project are:

- P&ID
- 3D model
- Orthographic
- Isometric

Additional data that could be used as part of a typical project are:

- Process information, such as stream tables.
- Equipment and instrument cut-sheets.
- Catalog and specs for piping.
- Structural analysis, if required.

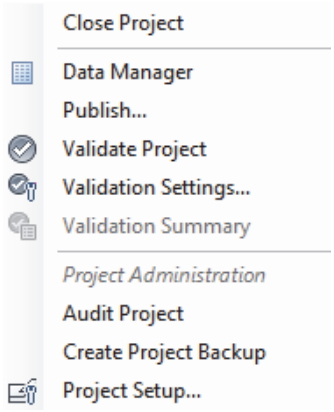
The following illustration shows how these components interact.



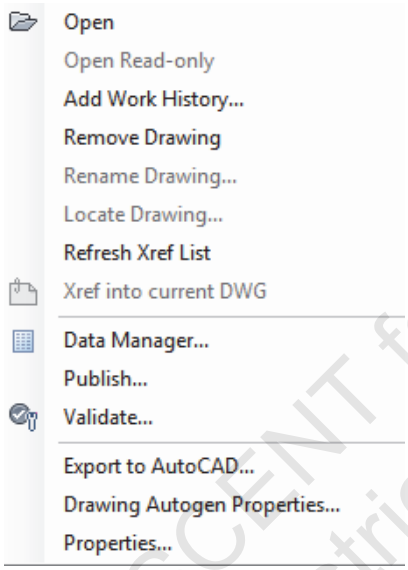
Sample provided by ASCENT for review only
All copying and reuse strictly forbidden

Project and Drawing Options

You can set options and other settings for the overall project or for individual components in the project. You find most of these settings on shortcut menus as shown in the following illustration. Properties of the overall project affect the project as a whole, and properties for individual components only affect those specific components.



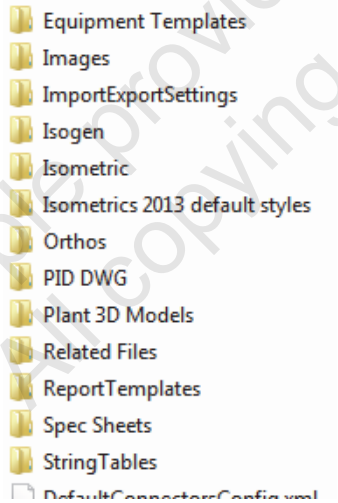
Project shortcut menu



Drawing shortcut menu

Data Organization

Data that is used in a project is organized in a system of default folders. If you work in a multiple user environment, it is recommended that you manage Plant projects with Vault or store the data in a centralized network location. An example project folder structure is shown in the following illustration:



Sample provided by ASCENT for review only
All copying and reuse strictly forbidden.

Project Files and Paths

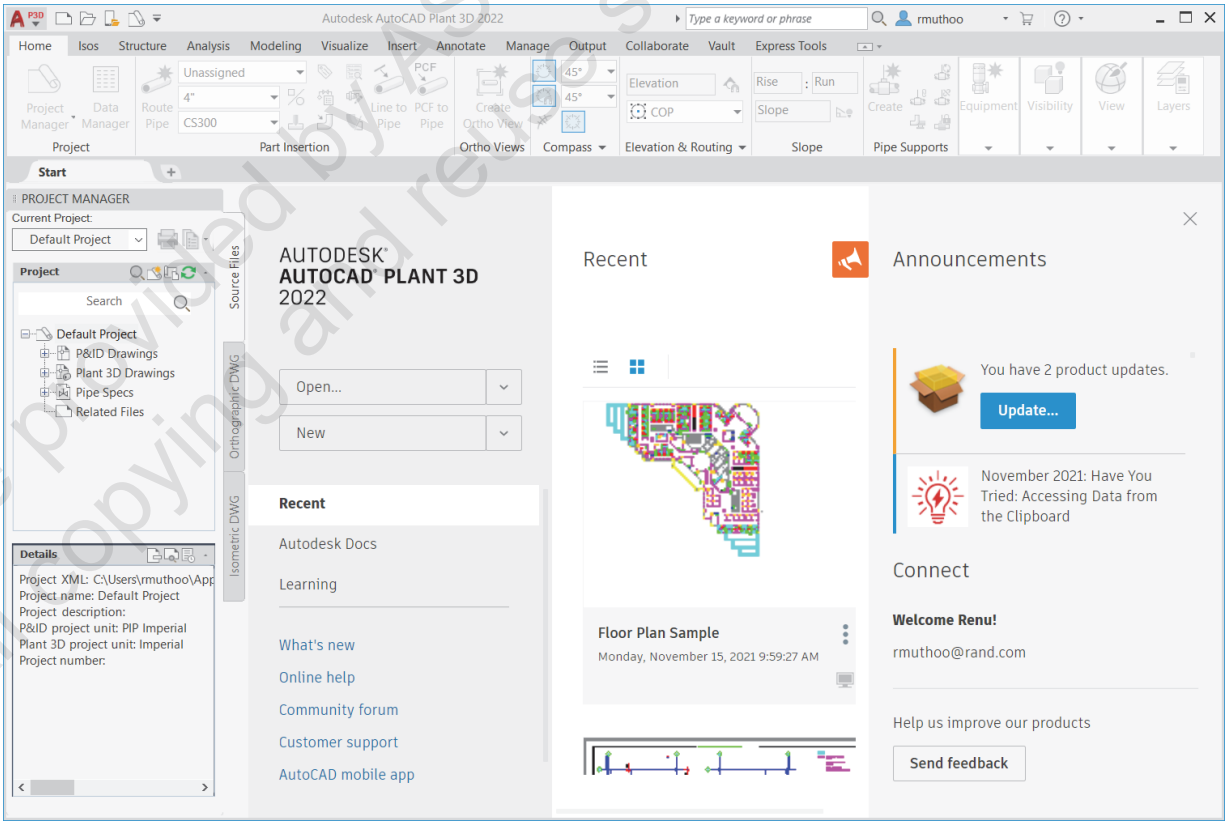
There are several ways to organize the files for a project. Files are most often stored under the P&ID Drawings or Plant 3D Drawings folder, or sub-folders, with the equivalent folder structure created in the Windows project directory. A separate folder for templates can be created to store company or project standards.

When a project is created you do not indicate whether it should be stored as a relative or absolute path. This is only required when you are using the XREF command to attach drawings to one another. Project folders are all created relative to the *Project.xml* file.

Once the project structure is set up, you can copy existing drawings that need to be used into the project. The Copy command duplicates the selected file and places it into the project folder structure defined in the project settings.

The Start Window

When you open the AutoCAD P&ID software or the AutoCAD Plant 3D software, you are presented with the Start window (as shown in the following illustration). By default, the Project Manager is displayed on the left side of the window. The next division contains drop-down lists that have options for creating new projects and sheet sets, opening existing projects, and opening collaboration projects. There are three buttons: Recent, Autodesk Docs, and Learning. Clicking these buttons opens relevant options and information on the right side of the Start window. A list of links is also provided to access online services such as What's new in the software, Online help, and the Community forum.



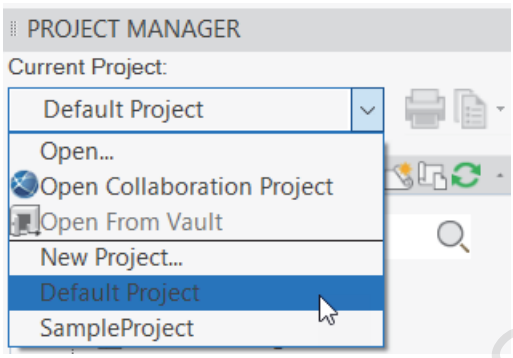
Sample provided by ASCENT for review only
All copying and redistribution is strictly forbidden.

About the Project Manager

The Project Manager provides access to the project-wide settings and data, as well as individual data components in the project. By default, the Project Manager is located on the left of the screen.

Current Project

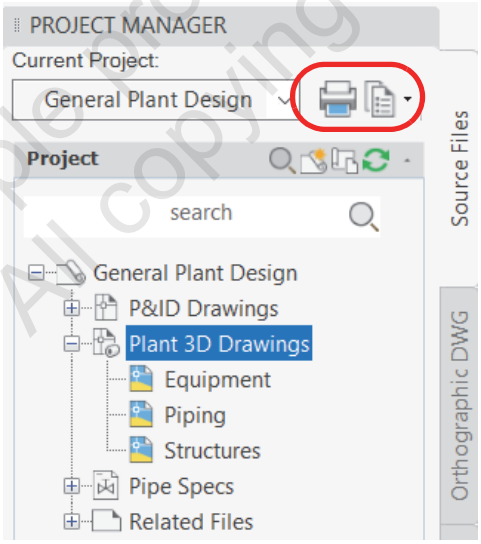
At the top of the Project Manager palette is the Current Project list, which shows the current project and enables you to select from other projects. Hovering over any of the project names in the drop-down displays a tooltip of the actual location of the project. Other options in the drop-down enable you to create a new project or to open an existing project, as shown in the following illustration.



Reports and Publish

In the Project Manager, to the right of the Current Project list are the Publish and Reports commands, as shown in the following illustration. These commands are accessible project-wide. The Reports command provides access to tools that include:

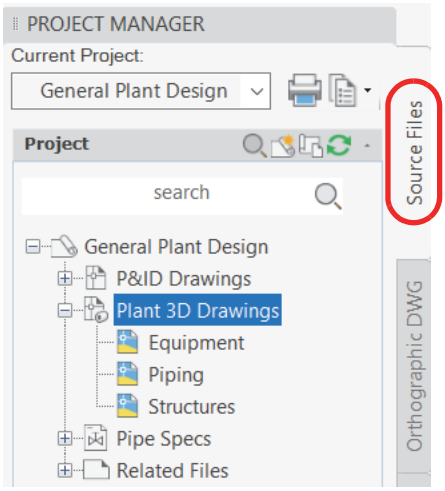
- Data Manager
- Import/Export
- Reports



Sample provided by ASCENT for review only
All copying and reuse strictly forbidden.

Project Panel

The Project panel displays a "tree-view" of the drawings in the project. The most common tab used is the Source Files tab, as shown in the following illustration. The drawings shown in the Source Files tab are P&ID drawings and 3D model files. The Orthographic DWG and Isometric DWG tabs contain output drawings generated from your 3D piping model.



There are four fixed top level folders: P&ID Drawings, Plant 3D Drawings, Pipe Specs, and Related Files folders. All these folders, except for the Pipe Spec folder, can have additional sub-folders created to organize and store drawings or other related project documents inside. Drawings, folders, and other items in the tree can be arranged as required by using standard Windows techniques, such as dragging and dropping. The Pipe Spec folder contains a listing of all the 3D piping specs included in the current project. Piping spec files can be added, removed, or edited in a project from this branch of the Project Manager.

The Related files folder is a convenient place to put links to documents associated with the project, such as cut sheets, spreadsheets, etc. The folder can have additional subfolders added to organize these files.

The Search bar at the top of the project panel is used to find files in the Project Manager when working with a large number of drawings. Entering the filename, or a part of the filename, displays the files that match the search criteria by temporarily filtering out all the other files.

The Project Manager takes advantage of the fact that what you see in the tree is a representation of the folder or drawing in the project. The drawing icons change based on what is happening to the drawings in the project. Some icon changes could include the indication of locked or missing drawings.

Details/Preview/History Panel

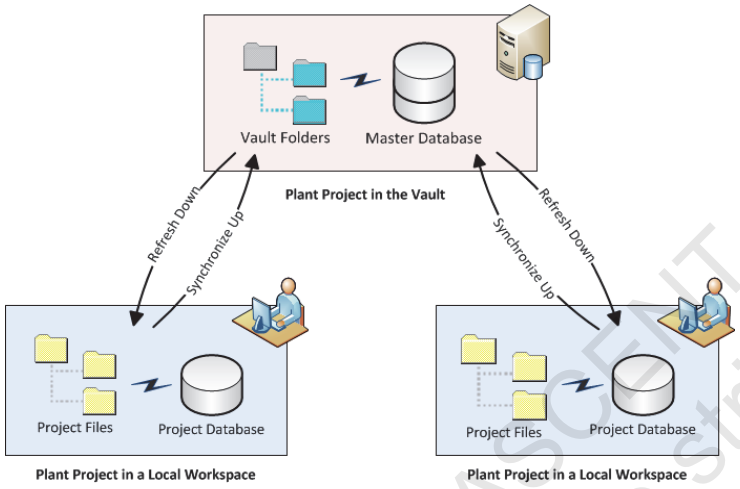
The bottom panel of the Project Manager provides information about the drawing selected in the project panel. This panel toggles between basic drawing details, drawing preview, and drawing history.

- **Details -** Provides basic details of the item selected, such as drawing location and size, the status of the drawing, and who created and worked on it last.
- **Preview -** Presents a thumbnail preview of the drawing selected.
- **Work History -** Provides a work history of the drawing. This enables you to track the status and notes added to a drawing.

Sample provided by ASCENT for review only
All copyright and reuse strictly forbidden.

About Vault Projects

Projects can be stored in the Autodesk Vault software and are opened using the Project Manager. AutoCAD Plant 3D Project administrators need the Vault client for certain operations, but a plant user should only use the Project manager to work with Vaulted files. When opened, a local workspace is created and files are copied from the vault. Any additional users accessing the project have separate local workspaces created on their systems. The project database in the local workspace is updated ( ) as you save files in the working folder, as shown in the following illustration. The project master database is updated when you check in files to the vault.



If you create a plant project in the vault, you can use the following vault-enabled features:

- **Local workspace -** Files are no longer kept on a network shared drive. Vault project files are modified in the local workspace and synchronized to the vault.
- **Check-in and check-out document management -** The Project Manager is fully integrated with the Autodesk Vault software. The Project Manager prompts you to check out the files as you work.
- **Automatic file versions -** You can view or restore the previous revision of a file.
- **Master project database -** Vault projects use SQL Server for the project database. The master database is always synchronized to match the files that are checked in to the vault.
- **User authentication and access control -** Administrators can manage access to a vault project using the Autodesk Data Management Console to set up user accounts and assign roles.

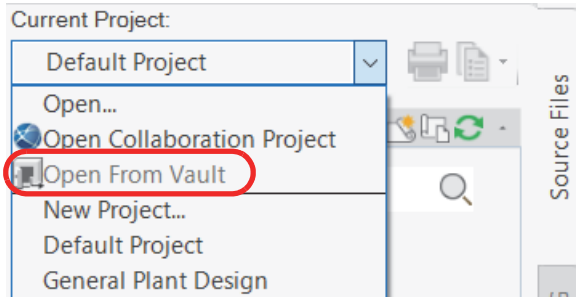
Getting Started with Vault

When your project administrator has provided you with a vault server location and credentials, you can use the Project Manager to open a project, as shown in the following illustration. The first time you open a vault project you specify the location of your working folder. Project files are then copied to your working folder from the vault.

Project files are initially read-only in your workspace folder. The Project Manager prompts you to check out files as you work. You can check in project files when your changes are complete. You can also synchronize to the vault to share your work-in-progress without checking in the files.

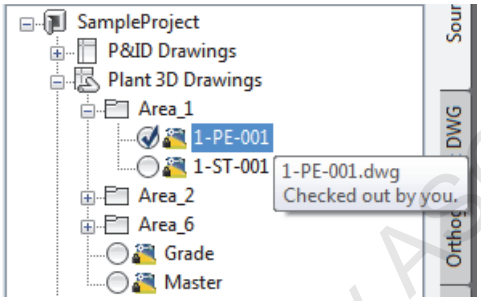
Important: Do not use the Autodesk Vault Client to work with plant projects.

Sample reviewed by ASCENT for review only
All copying or reuse strictly forbidden.



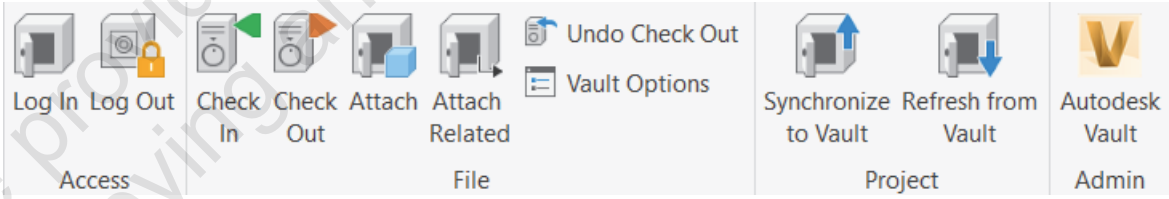
Project Manager

Vault project and file management features are integrated directly into the Project Manager. If a vault project is opened, the Project Manager displays a vault project type which displays next to the project name. Files in the project display for the check-out status when checked out. Hover the cursor over the filename to identify who has the file checked out, as shown in the following illustration.



Vault Ribbon

You can manage your vault log-in session and vault project files from the ribbon, as shown in the following illustration.



- When working with vault projects, the AutoCAD Plant 3D software prompts you to log in. Autodesk Vault log-ins are maintained for the duration of the drawing session unless you log out. If you want to access a different vault, you must log out first.
- The Log In/Log Out options in the ribbon enable you to log into and out of the vault.
- The Check In option in the ribbon enables you to check a file in for the first time or check a file back into the vault.
- The Check Out option in the ribbon enables you to check a file out of the vault.
- The Undo Check Out option in the ribbon enables you to undo a file checkout.
- The Synchronize to Vault option in the ribbon uploads the file's data to vault while maintaining the checkout.
- The Refresh from Vault option in the ribbon updates the file with the properties from the vault.

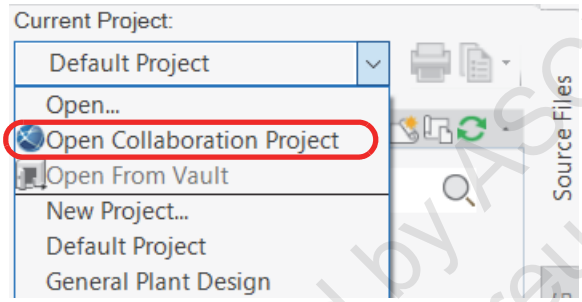
Sample provided by ASCENT for preview only
All copying and reuse strictly forbidden.

About Collaboration Projects

AutoCAD Plant 3D projects can be hosted on BIM 360 Team and are opened using the Project Manager. A project located on a BIM 360 Team hub can be accessed and edited, outside a company's network, by anyone connected to the internet. The project administrator can share projects from the BIM 360 Team hub and invite users with read-only or read/write permission to a project. Collaboration projects hosted in the cloud are downloaded to the local computer and edited in Plant 3D like any other project. Similar to a Vaulted AutoCAD Plant 3D project, collaboration project drawings are checked-out and checked-in as work is completed on them. A collaboration project must be created locally and then uploaded to BIM 360 Team.

Getting Started with Collaboration Projects

Once you have a BIM 360 account and you have been invited to join a collaboration project hosted on the BIM 360 Team, you use the Project Manager to open the project, as shown in the illustration below. You must first be logged in to Autodesk to open a collaboration project. Then, to open the collaboration project, select the Open Collaboration Project menu item from the Project Manager. If you have been invited to a project, select the project from the list of available Plant projects. Project files are then copied to your local computer.



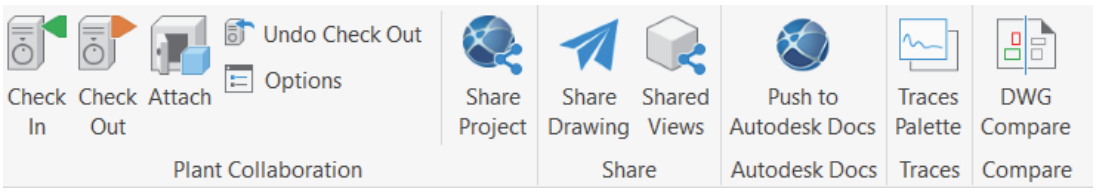
Project Manager

All Project files are initially read-only on your local computer. Opening a drawing from the Project Manager will automatically check-out the file for editing. After making any changes to the drawing file, saving and closing the drawing will automatically check the file back in and upload a copy to Autodesk Docs for all other users to see. You can also check-out and check-in files manually.

Collaboration project and file management features are integrated into the Project Manager. If a collaboration project is opened, the Project Manager displays the project type next to the project name. Files in the project display a check-out status when checked out. Hover the cursor over the filename, or view the details panel in the Project Manager, to identify who has a file checked out.

Collaboration Ribbon

You can share and manage project files to Autodesk Docs from the ribbon as well as perform other collaboration project commands, as shown in the following illustration.

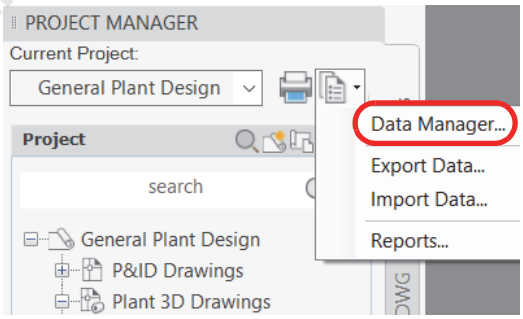


Sample provided by ASCENT for preview only.
All drawing and reuse strictly forbidden.

- The Share Project button enables you to upload a local project to Autodesk Docs. Once uploaded, users in other locations can be invited to join the collaboration project.
- The Check In option in the ribbon enables you to check a new file in to the collaboration project for the first time or check a file back in after making changes. A check-in uploads the file to the cloud for others to view it.
- The Check Out option in the ribbon enables you to check out a file for editing. You can either check out the files manually or they automatically checkout when opened.
- The Undo Check Out option enables you to cancel changes and revert to the copy previously stored in the project.
- The Attach option enables you to Xref other drawings in the collaboration project to your open drawing.
- The Share Drawing tool enables you to collaborate with others by sharing a virtual link to a copy of the currently open drawing file with them. With the Share Drawing tool, you can share drawings along with all the relevant referenced files, such as Xrefs, images, and font file types. The copy of the drawing being shared is stored on the cloud and can be accessed anytime and from anywhere. The link to the drawing file can be shared with others, and they can review, mark up, and edit the drawing in the Autodesk® AutoCAD® web app. Recipients can make changes to the copy of the drawing file with no access to the original drawing file that is owned by the sharer.
- Shared Views creates views for sharing your designs with stakeholders and are a great alternative to printing .PDF and .DWF files. Shared views are stored in the cloud and can be viewed and commented on by any web enabled desktop, tablet, or mobile device.
- The Push to Autodesk Docs feature allows project members to upload drawing layouts from multiple drawings to an Autodesk Docs project as a PDF. This enables team members to view the digital PDFs of drawings while they are in the field.
- Trace provides a safe space to add changes to a drawing in the web and mobile apps without altering the base drawing. Traces are created in the web and mobile app interface and then saved on the cloud to be shared with other collaborators on the team.
- DWG Compare provides a way to quickly highlight the differences between two versions of the same drawing file or two different drawing files.

About the Data Manager

When you add items to a P&ID or to a 3D model, you are not just adding graphics to a drawing. Each item added to a drawing can contain properties in addition to the graphical symbol in the drawing screen. The Data Manager provides a database view into your project and the data in the project. You can access the Data Manager using the Reports command in the Project Manager. You can also access the Data Manager by right-clicking on the P&ID Drawings node or AutoCAD Plant 3D Drawings node in the Project Manager and clicking Data Manager, as shown in the following illustration.

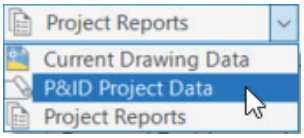


Sample provided by ASCENT for review only
All copying and reuse strictly forbidden.

You use the Data Manager to create reports and import/output from your project data. You can also change the data in the drawing by entering required values in the Data Manager.

As shown in the following illustration, the Data Manager information can be filtered to present:

- Current Drawing Data
- P&ID Project Data or AutoCAD Plant 3D Project Data (varies depending on the selected drawing type)
- Project Reports



Sample provided by ASCENT for review only
All copying and reuse strictly forbidden.

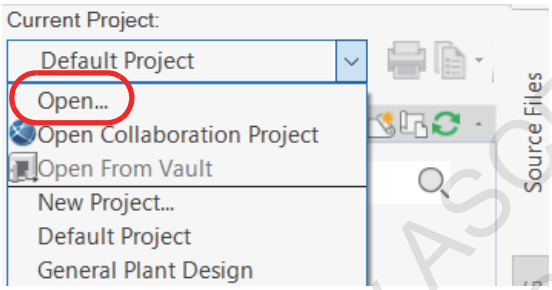
Exercise: Work in a Project

In this exercise, you open a project and examine the various settings and data in the project. You then explore project-wide options, and drawing-specific settings.

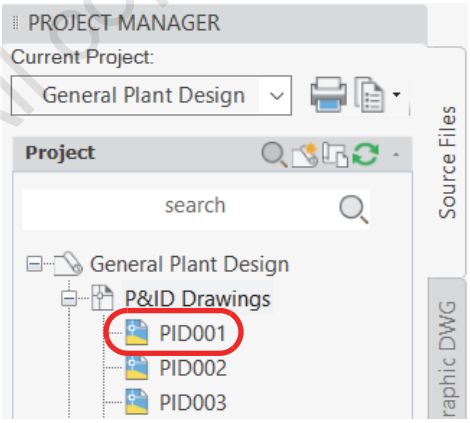
Import a Project

In this section of the exercise, you open a project and examine the various settings of the drawings and data in the project.

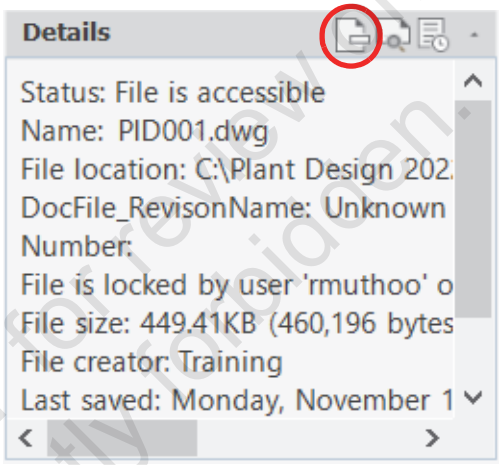
1. Start the AutoCAD Plant 3D software.
2. In the Project Manager, for Current Project, click Open.



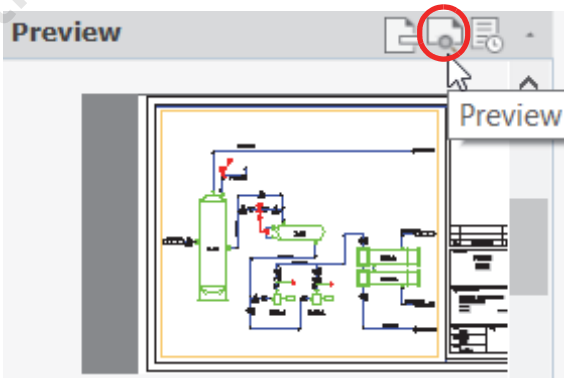
3. Set General Plant Design as the current project as follows:
   - In the Open dialog box, navigate to the folder *C:\Plant Design 2022 Practice Files\General Plant Design*.
   - Select the file *Project.xml*.
   - Click Open.
4. On the Source Files tab, expand P&ID Drawings on the Project panel. Double-click on PID001 drawing to open it. Save it.



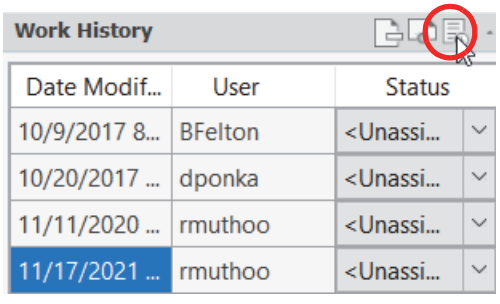
5. In the lower section of the Project Manager, examine the details of the drawing. The Details button should be selected.



6. Click Preview to preview the drawing.

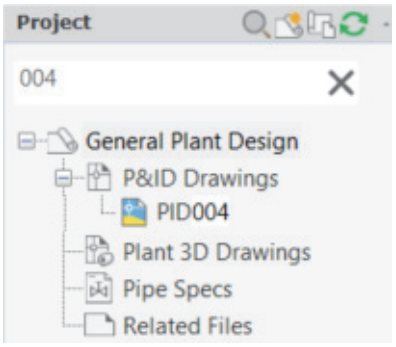


7. Click Work History to view the history of the drawing.



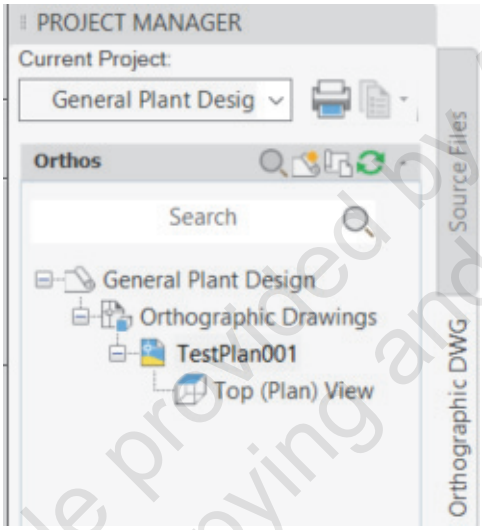
Samples provided by ASCENT for review only
All copying and reuse strictly forbidden.

8. In the Search bar, type 004 and press <Enter>. Note that PID004 is displayed and all other drawings are hidden.

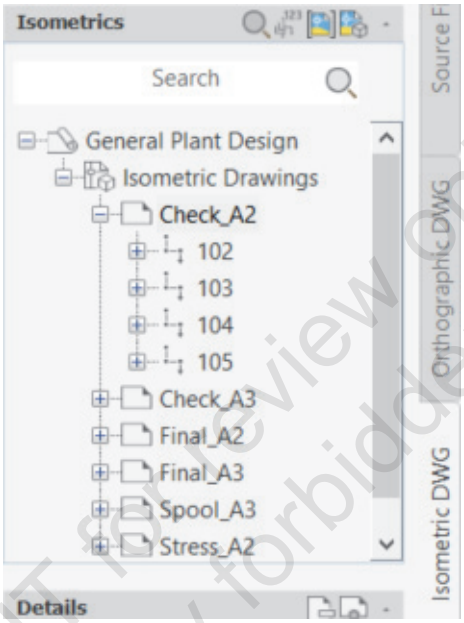


9. Click X in the Search bar to clear the search and display all drawings.

10. On the right side of the Project Manager, click the Orthographic DWG tab. Expand the nodes in the Orthos panel to examine the Ortho data.

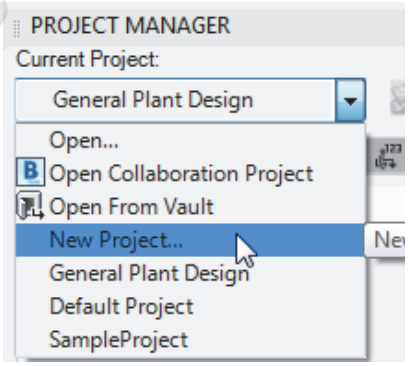


11. Click the Isometric DWG tab. Expand the nodes in the Isometrics panel to examine the Isometrics data.

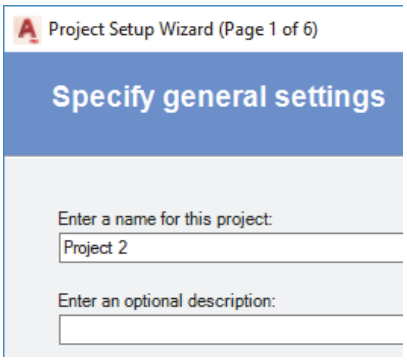


Project-Wide Options

1. In the Project Manager, for Current Project, click New Project to start the Project Setup Wizard.



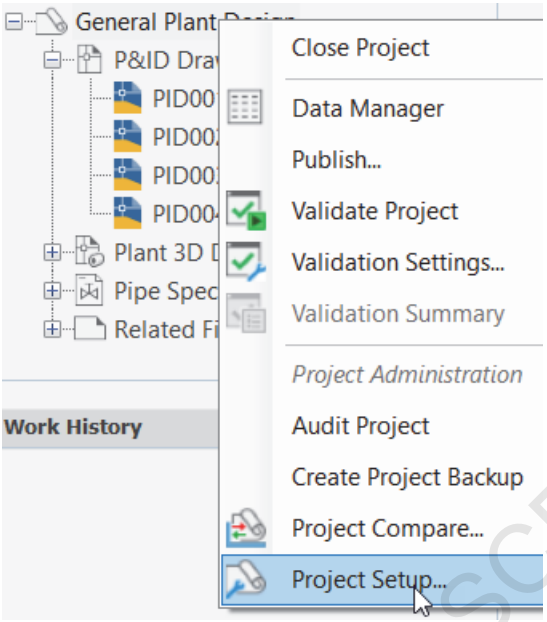
2. Examine the general settings available on the first page of the wizard.



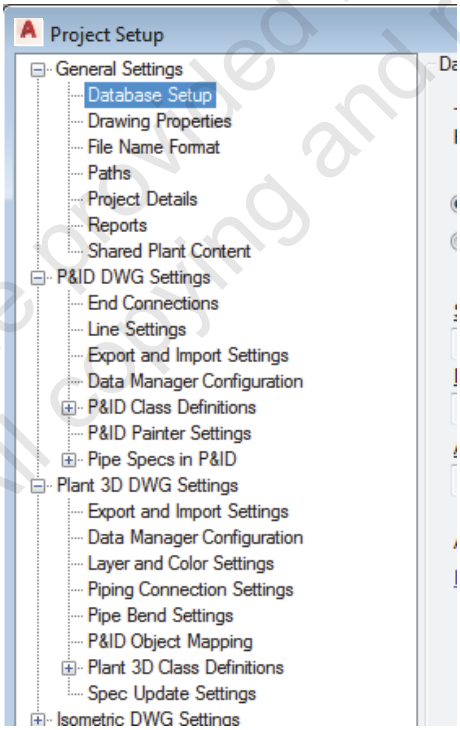
Sample provided by ASCENT for review only
All copying and reuse strictly forbidden.

3. Click Cancel. Click Yes. You do not create a new project in this exercise.

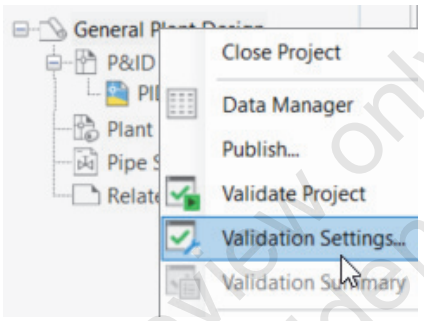
4. In the Project Manager, right-click on General Plant Design. Click Project Setup.



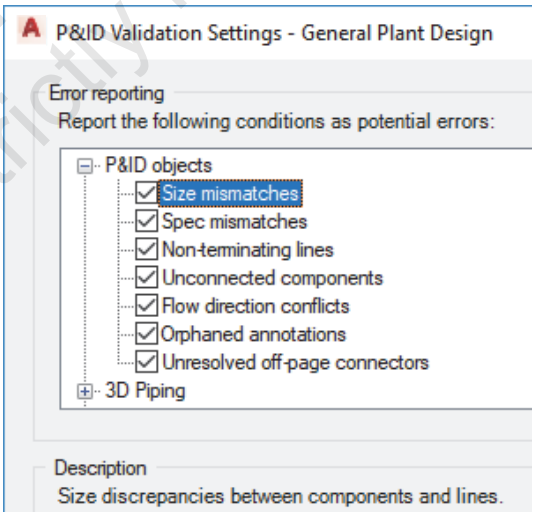
5. In the Project Setup dialog box, examine the settings and options available for the Project Details. When finished, click Cancel.



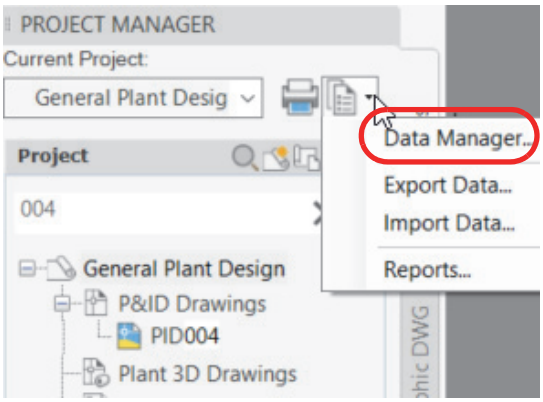
6. In the Project Manager, right-click on General Plant Design. Click Validation Settings.



7. In the P&ID Validation Settings dialog box, select some of the error reporting conditions and review the descriptions. When finished, click Cancel.

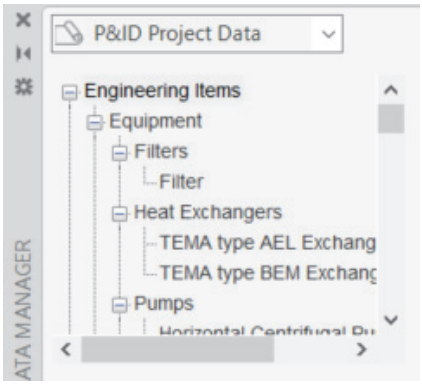


8. At the top of the Project Manager, under Reports, click Data Manager. This gives access to the database that is behind the drawings.



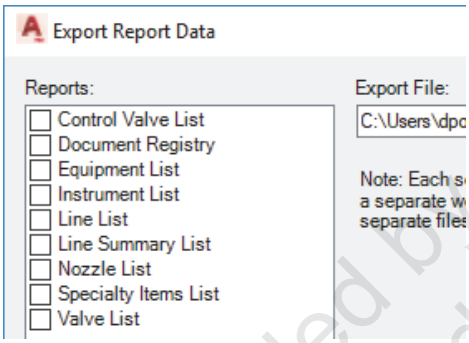
Sample manual provided by ASCENT - Preview only
All copying and reuse strictly forbidden.

9. Examine the data in the Data Manager.



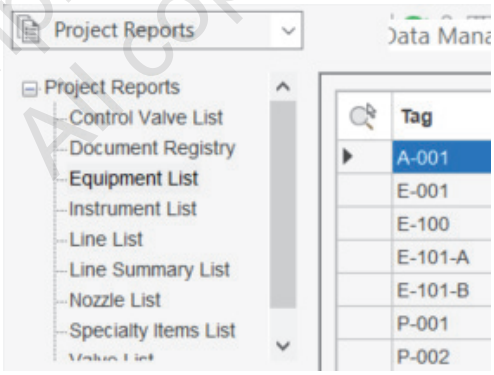
10. Close the Data Manager.

11. At the top of the Project Manager, under Reports, click Export Data. In the Export Report Data dialog box, examine the Reports available.



12. Click Cancel to close the Export Report Data dialog box.

13. At the top of the Project Manager, under Reports, click Reports. From the Project Reports list, select Equipment List. Examine the report data.



14. Close the Data Manager.

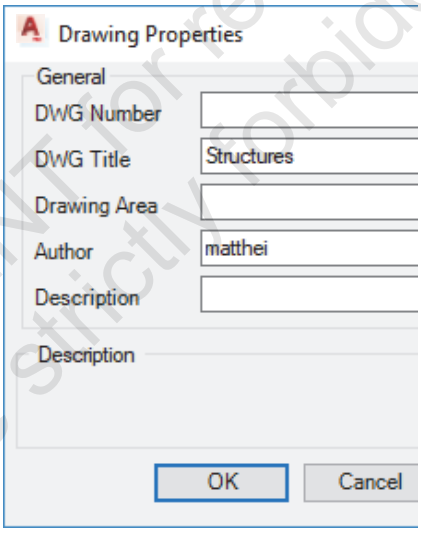
Drawing Options

In this section of the exercise, you examine settings and options for specific drawings in the project.

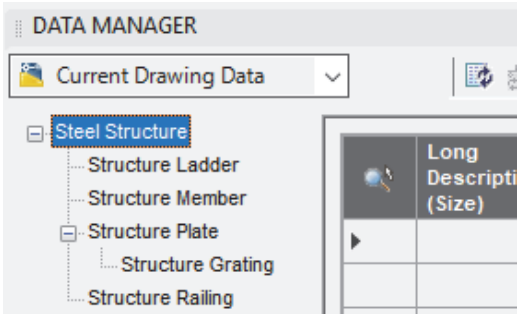
1. In the Project Manager, click the Source Files tab, if required.

2. Expand Plant 3D Drawings. Right-click on the Structures drawing. Click Properties.

3. Examine the Drawing Properties dialog box. When finished, click Cancel.



4. Right-click on the Structures drawing. Click Data Manager. The drawing is opened and the Data Manager is displayed. This is a filtered version of the Data Manager that shows only data from this specific drawing, and not the entire project.



5. Close the Data Manager.

Sample provided by ASCENT for review only. All copying and reuse strictly forbidden.

Lesson Review Questions

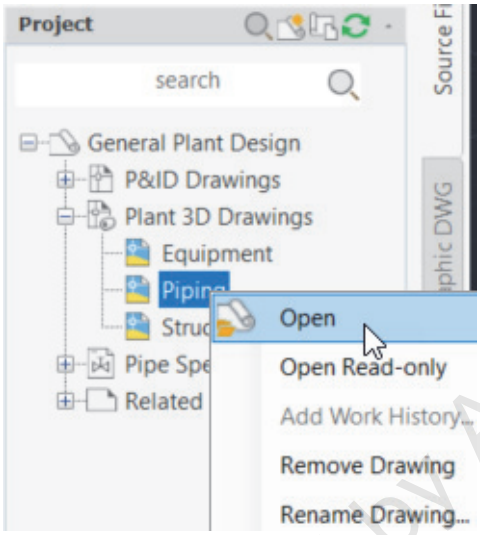
1. An AutoCAD Plant 3D project only consists of DWG files.
   a. True
   b. False
2. What are the types of 2D drawings generated from the 3D Model? (Select all that apply.)
   a. Orthographic
   b. Process flow diagrams
   c. Isometric
   d. P&IDs
3. You can add and edit data fields in the Data Manager.
   a. True
   b. False
4. Which of the following statements is true regarding data organization for your projects? (Select all that apply.)
   a. Data for a project is organized in a set of system defined folders.
   b. Drawings that are stored outside the project folder structure cannot be copied into the project.
   c. Drawings that are copied into a project are included in the project's folder path.
   d. Drawings that already exist in the project folder are duplicated when copied into the Project Manager.

Sample provided by ASCENT for review only
All copying and reuse strictly forbidden.

Lesson: Opening a Drawing

Overview

When you are working in Windows applications, such as the AutoCAD P&ID software and the AutoCAD Plant 3D software, there are many different ways to open files. While there are multiple ways in which you can open a drawing file, the best way to access drawings is through the Project Manager. To realize the full benefit of projects and the Project Manager, you must know how to open drawings in the context of the project and from inside the Project Manager, as shown in the following illustration.



Objective

After completing this lesson, you will be able to:

- Describe how the AutoCAD P&ID software and the AutoCAD Plant 3D software work with drawings.

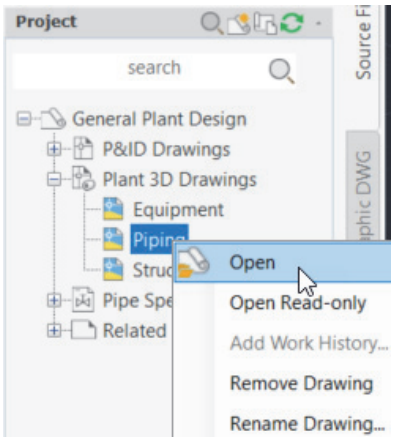
Sample provided by ASCENT for review only
All copying and reuse strictly forbidden.

Opening Drawings

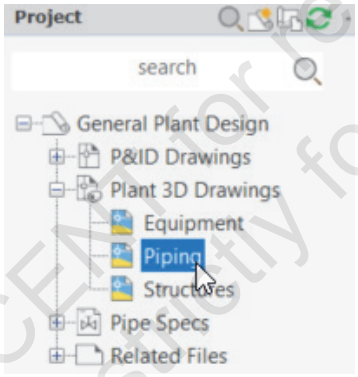
The best way to access the project and the drawings in the AutoCAD P&ID software or the AutoCAD Plant 3D software is through the Project Manager.

As shown in the following illustrations of the Project Manager, you open the drawings in the Project pane by:

- Using the shortcut menu.
- Double-clicking the drawing.



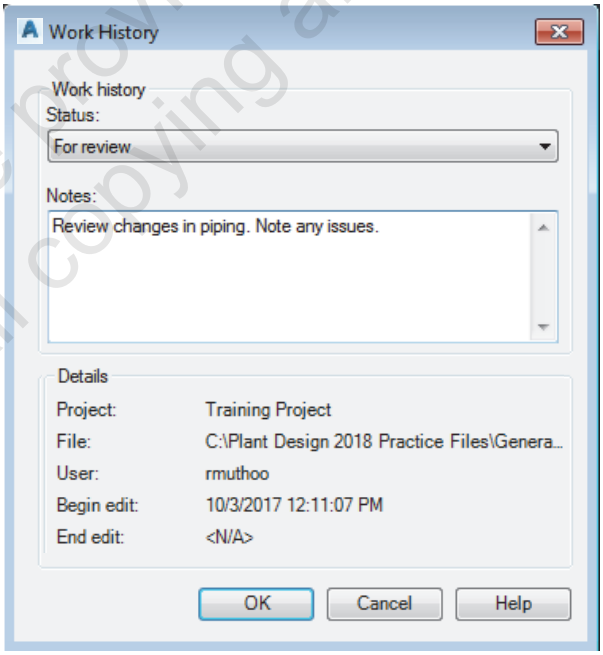
Right-click



Double-click

Drawing History

If the project has been set up to prompt for work history when you open a project, a dialog box opens when the drawing is open in the editor to enable you to enter work history information, as shown in the following illustration.

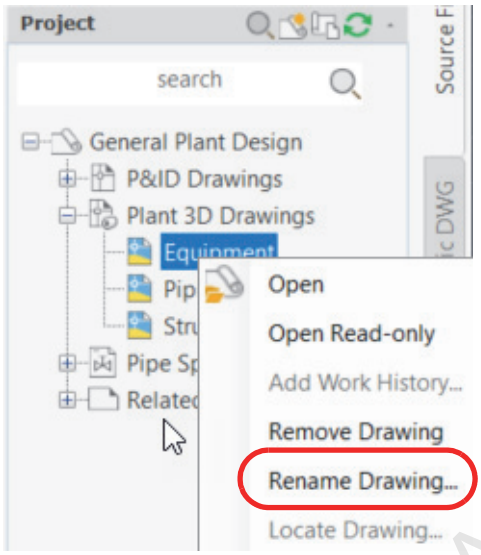


Sample provided by ASCENT for review only. All copying and reuse strictly forbidden.

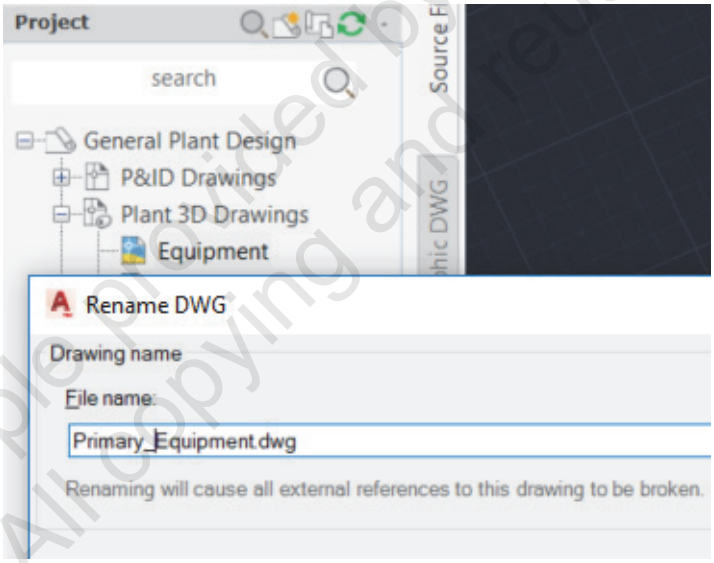
Renaming Drawings

Drawings can be renamed from the Project Manager. To do so, right-click on the drawing in the Project Manager and click Rename Drawing. The Rename DWG dialog box opens and you enter the new name. After clicking OK, the new name is displayed in the Project Manager and the file in the project is also renamed.

Access to renaming drawings from the Project Manager is shown in the following illustration.



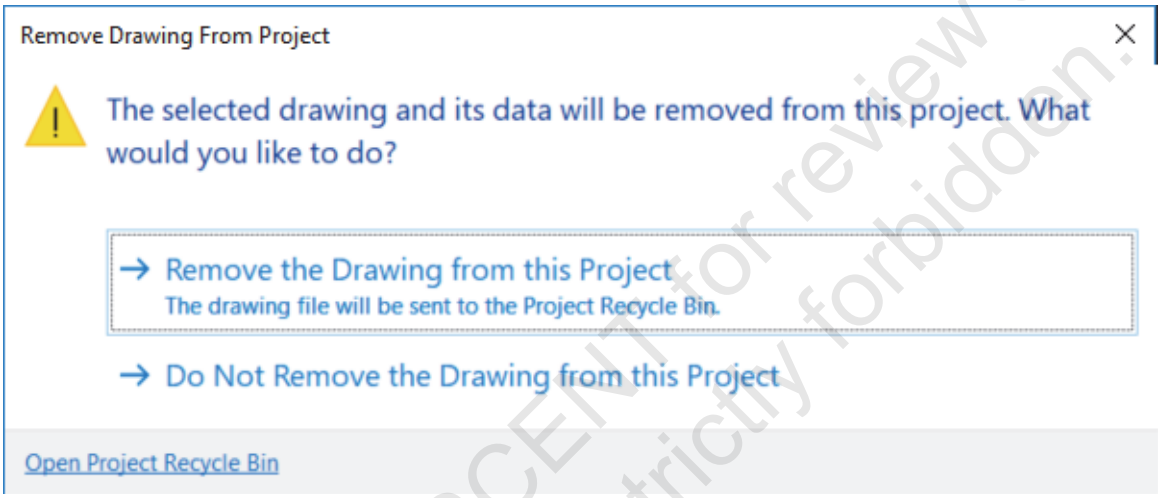
A drawing being renamed in the Rename DWG dialog box is shown in the following illustration.



Sample Provided by ASCENT for review only
All copying and reuse strictly forbidden.

Removing Drawings

Drawings can be removed from a project using the Project Manager. To do so, right-click on the drawing in the Project Manager and click Remove Drawing. The Remove Drawing From Project dialog box opens. Click Remove the Drawing from this Project to confirm the removal of the drawing from the project. When removed, the drawing is not deleted or removed from the project folder. It is only removed from the project.



Sample provided by ASCENT for review only
All copying and reuse strictly forbidden.

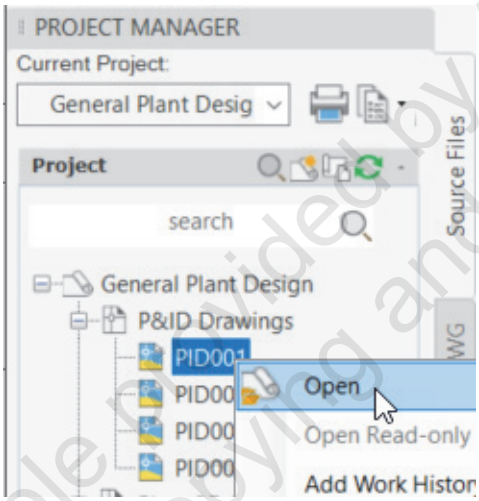
Exercise: Open a Drawing in AutoCAD Plant 3D

In this exercise, you open and close drawings in the AutoCAD Plant 3D software using various tools and options.

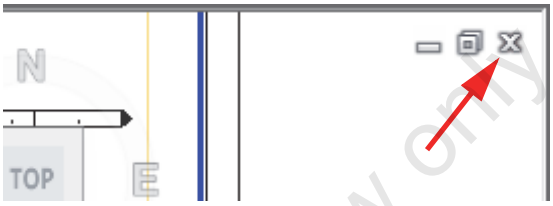
1. Start the AutoCAD Plant 3D software, if not already running.

2. Set General Plant Design as the current project as follows (if not already set):
   - In the Project Manager, Current Project list, click Open.
   - In the Open dialog box, navigate to the folder *C:\Plant Design 2022 Practice Files\General Plant Design*.
   - Select the file *Project.xml*.
   - Click Open.

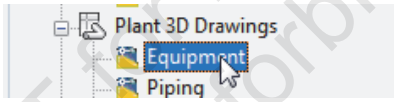
3. Under P&ID Drawings, right-click on the PID001 drawing. Click Open. (You might have the drawing file already open.)



4. To close the PID001 drawing without closing the AutoCAD Plant 3D software, in the drawing window, click X (Close) in the top right corner of the drawing or click X with the PID001 filename in the File tabs bar. If you are prompted to save changes, click No.

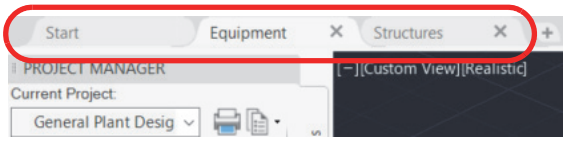


5. You can open a drawing by double-clicking the drawing in the Project Manager. Under Plant 3D Drawings, double-click on the Equipment drawing.



6. You can open multiple drawings. With the Equipment drawing still open, in the Project Manager, double-click on the Structures drawing.

7. You can switch between open drawings by selecting the drawing tabs above the Project Manager. In the tabs bar, select the Equipment tab.



8. To close the Equipment drawing, click X (Close) on the Equipment tab. If you are prompted to save changes, click No.

9. Another option to close drawings is to use the Application menu in the upper-left corner of the AutoCAD Plant 3D software. In the menu, hover the cursor over Close. This gives you the option to close either the current drawing or all drawings. Click All Drawings to close all the open drawings.

Sample material provided by ASCENT for review only. Any copying and reuse strictly forbidden.

Lesson Review Questions

1. After you add a drawing to the project, it should only be opened using the Project Manager.
   a. True
   b. False
2. The AutoCAD Plant 3D software keeps a history of all the times a drawing has been opened and saved in a single session.
   a. True
   b. False
3. What are the ways a drawing can be opened from the Project Manager? (Select all that apply.)
   a. Select the drawing and enter O for Open.
   b. Right-click on the drawing. Click Open.
   c. Double-click on the drawing.
   d. Select the drawing and double-click on the drawing in the preview window.
4. What are the ways in which a drawing can be closed? (Select all that apply.)
   a. Click Close (X) in the program's Title Bar.
   b. Click Close (X) in the drawing's working window.
   c. Click Close (X) in the drawing's tab.
   d. In the Application menu, under Close, click Current Drawing.
5. You can have multiple drawings open at the same time in the AutoCAD Plant 3D software.
   a. True
   b. False
6. What happens if you use the Remove Drawing shortcut menu option on a file in the Project Manager tree?
   a. You remove the file from the project, but the file stays where it is on the drive.
   b. You remove the file from the project and the file is deleted from the drive.
7. The Project Manager identifies whether someone else is working on a project drawing.
   a. True
   b. False

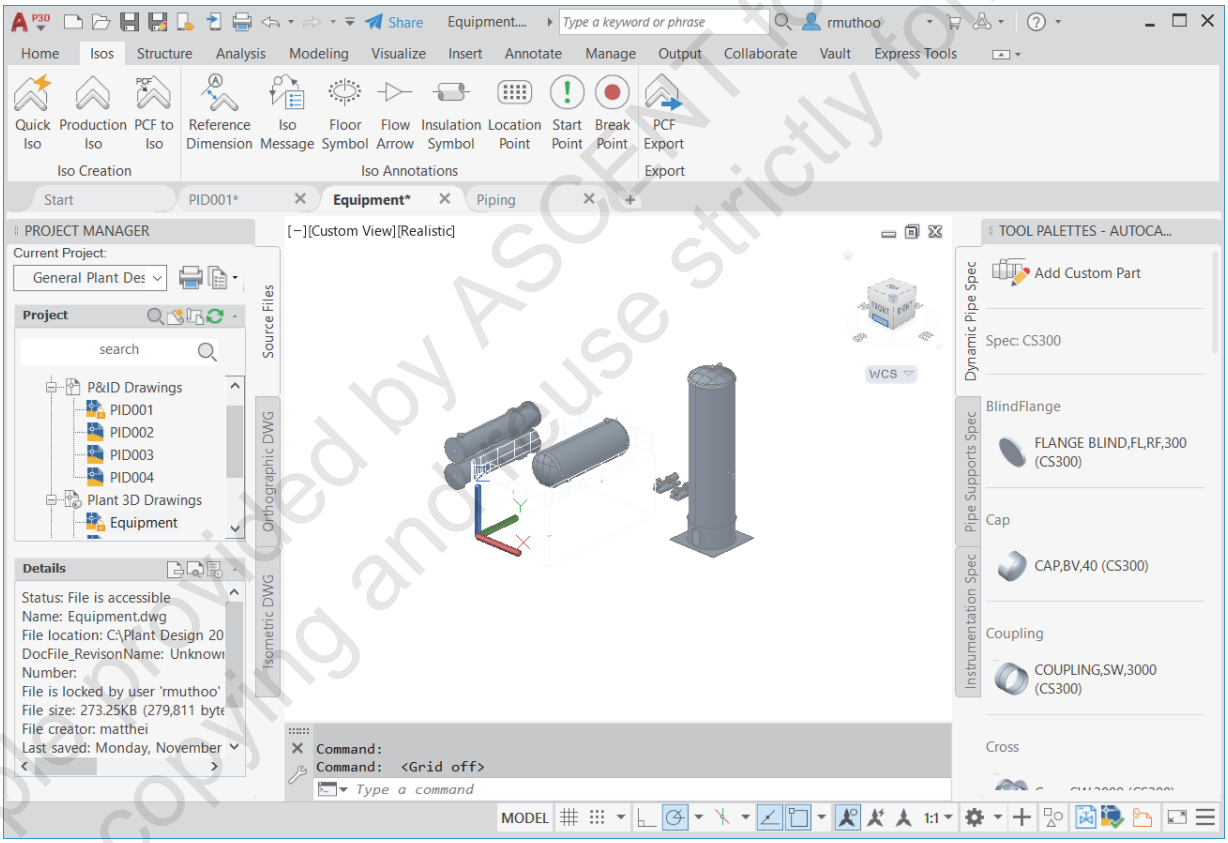
Sample provided by ASCENT for review only
All copying and reuse strictly forbidden.

Lesson: Exploring the User Interface

Overview

In this lesson, you learn how the AutoCAD Plant 3D commands are integrated into the standard AutoCAD user interface.

The AutoCAD Plant 3D software is built on the AutoCAD software, and uses AutoCAD commands as a basis, with some AutoCAD Plant 3D commands added to the ribbon menus, Properties palette, and shortcut menus. The approach is the same for both the P&ID and the 3D parts of the AutoCAD Plant 3D software. Some of the commands are for different types of items, whether they are in 2D or 3D. You can use the Workspace command to determine which set of commands you want to use, as shown in the following illustration.



Objectives

After completing this lesson, you will be able to:

- Identify how different workspaces are organized.
- Explain how ribbons integrate AutoCAD Plant 3D and standard AutoCAD commands.
- Describe how tool palettes are organized.
- State the data that is added to the Properties palette.
- Describe on-screen tools added to the AutoCAD Plant 3D software.

Sample provided by ASCENT for review only
All copying and reuse strictly forbidden.

Task-Specific Workspaces

In this section of the lesson, you explore how workspaces are integrated in the AutoCAD P&ID software and the AutoCAD Plant 3D software.

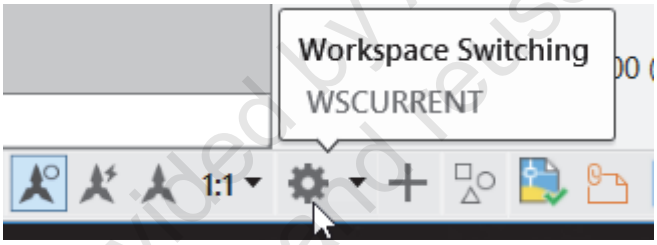
Workspaces Defined

The Workspace command enables you to set up and customize sets of commands so that they arrange the interface to meet your needs. The AutoCAD P&ID software and the AutoCAD Plant 3D software adds several new workspaces to the standard AutoCAD software:

- 3D Piping
- PID PIP
- PID ISO
- PID ISA
- PID DIN
- PID JIS-ISO

The primary difference between the P&ID workspaces is the palettes of symbols that are displayed. These change based on the P&ID standard on which the workspace is based.

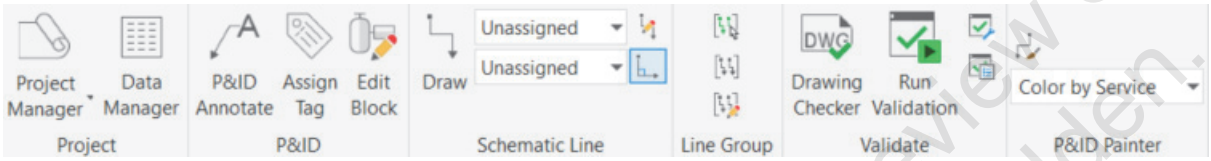
You change the workspace using the Workspace Switching command on the AutoCAD status bar, as shown in the following illustration. Clicking on the arrow opens the Workspace drop-down list where you can select the workspace as required. Alternatively, you can customize the Quick Access toolbar to display the Workspace drop-down list and use this to assign the Workspace.



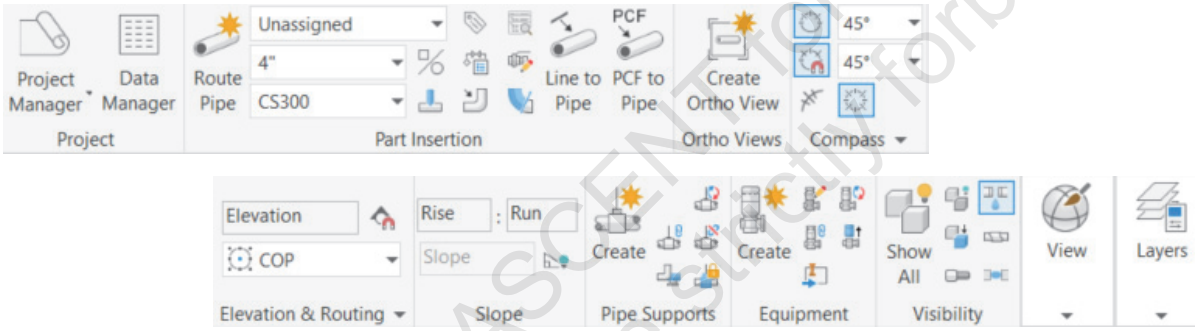
Sample provided by ASCENT for review only
All copying and reuse strictly forbidden.

Task-Specific Ribbons

The main method of interaction in the AutoCAD P&ID software and the AutoCAD Plant 3D software is the ribbon. To make design creation and editing easier, the commands for creating and editing a P&ID or 3D plant design are arranged in ribbon panels that are grouped by task, as shown in the following illustrations. The majority of these task-specific panels are located on the Home tab. The panels displayed on the Home tab vary based on the active workspace.



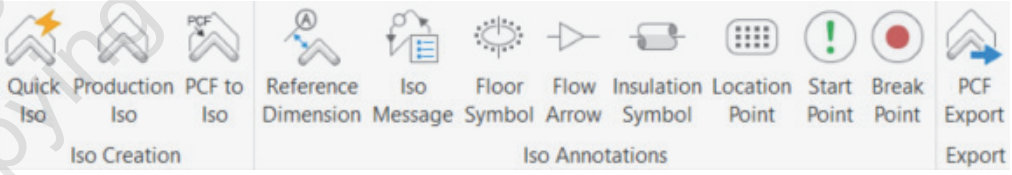
P&ID Home Tab Panels



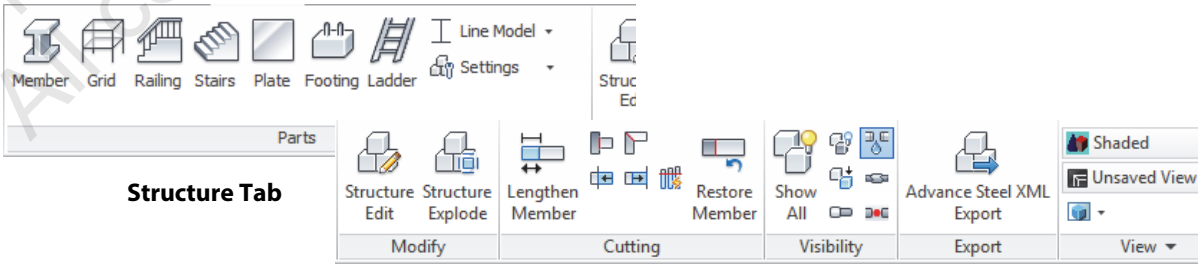
3D Piping Home Tab Panels

Isos and Structure Tabs

When the 3D Piping workspace is active, in addition to the panels on the Home tab, you can access the Isos tab and the Structure tab, as shown in the following illustration. The Isos tab contains commands dealing with isometric generation. The Structure tab has commands dealing with structural part generation in the 3D model space.



Isos Tab



Structure Tab

Sample provided by ASCENT for review only. Any copying and reuse strictly forbidden.

You can drag a panel out of the ribbon and place it anywhere on the screen. This enables you to have the commands on that panel available, even though you might click on another tab on the ribbon.

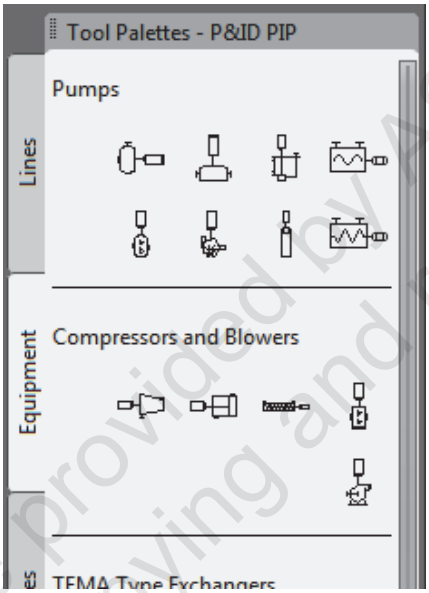
There are additional context tabs that appear when you are in an orthographic drawing.

About Tool Palettes

Tool palettes in the AutoCAD P&ID software and the AutoCAD Plant 3D software contain items specific to the workspace you are working in. The differences between the P&ID workspaces are primarily in the symbols available on the tool palettes.

P&ID Tool Palettes

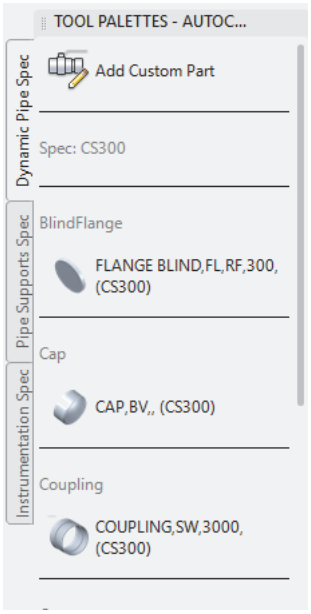
The P&ID tool palettes are divided into tabs, as shown in the following illustration. The symbols on each tab are grouped to be similar in layout to the class definitions in the project setup. Additional custom symbols that are created for use in a project can be added to these palettes. In addition, in a multi-user project, a set of common tool palettes can be created. You change the palette that is displayed by clicking on the tool palettes properties and selecting another palette.



Sample provided by ASCENT for review only
All copying and reuse strictly prohibited

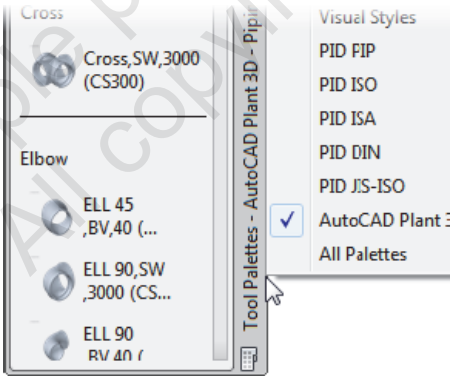
3D Tool Palettes

In the 3D Piping workspace, the Tool Palette is divided into three tabs: Dynamic Pipe Spec, Pipe Support Spec, and Instrumentation Spec as shown in the following illustration. Each tab contains a selection of items for the active specification. The Dynamic Pipe Specification tab contains specific information for the current pipe specification. The current pipe specification can be assigned using the Spec Selector list on the Part Insertion panel on the Home tab. To view the spec in more detail, click the Spec Viewer command on the Part Insertion panel. Once selected, the Pipe Spec Viewer Tool Palette is populated with the components in that specification.



Changing Tool Palettes

You can switch between the tool palettes by right-clicking on the title bar, and selecting the tool palette from the menu, as shown in the following illustration. While you can switch to a different palette at any time, you typically do so if you switch from working on a P&ID to working on a 3D model. In this case, the Tool Palettes automatically change when you switch Workspaces. Switching to a different standard in the same P&ID is not typically done nor required.



You can customize the tool palettes using standard AutoCAD customization commands.

Sample provided by ASCENT for review only
All copying and reuse strictly forbidden.

About the Properties Palette

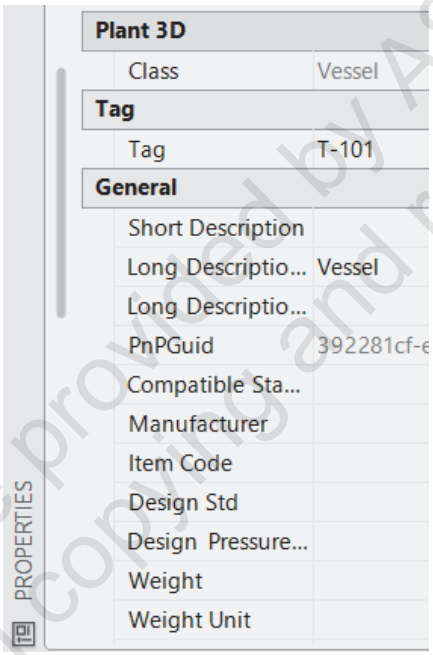
The Properties palette is a useful tool for viewing and changing properties of items that you select in the drawing. It is recommended that you leave the Properties palette open and docked, so that as you work with items you can view and access the properties of those items.

Accessing the Properties Palette

To access the Properties palette:

- Double-click on the item.
- Right-click on the item. Click Properties.
- Enter Properties in the command line.
- Press <Ctrl>+1.

The AutoCAD Plant 3D software adds a section to the Properties palette that is specific to the selected item, as shown in the following illustration. For example, if you are working on a P&ID and select a valve, a P&ID section is displayed at the bottom of the Properties palette with P&ID properties. If you are working on a 3D piping drawing and select a valve, an AutoCAD Plant 3D section is displayed with 3D properties of that object. The AutoCAD Plant 3D list of properties can be quite long because a lot of properties are involved with the 3D model, including but not limited to, pipe specs and part geometry.



Sample provided by ASCENT for review only
All copying and reuse strictly forbidden.

On-Screen Tools

The following commands and options are available when you select or hover over an item in the drawing window. These options vary based on the drawing type and item selected.

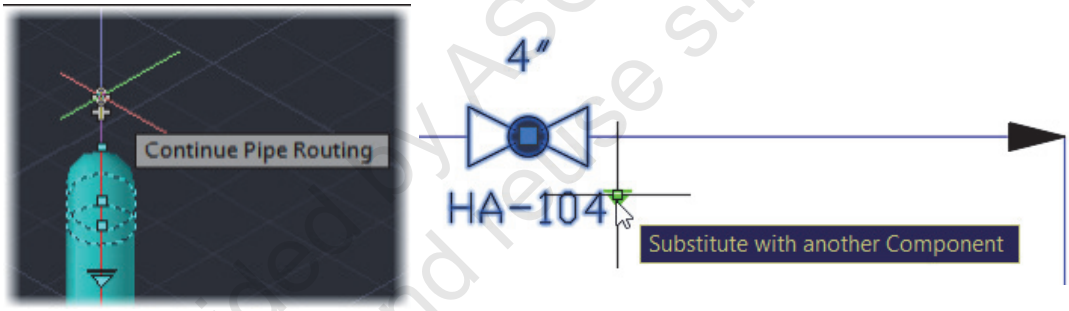
Grips

A single click on an item in the drawing window selects the item and displays any grips that are applicable to it. These grips enable you to modify the item in specific ways. Following is a partial list of some of the AutoCAD Plant 3D-specific grips available, depending on what item you have selected:

- Continuation grip
- Endline grip
- Substitution grip
- Add nozzle

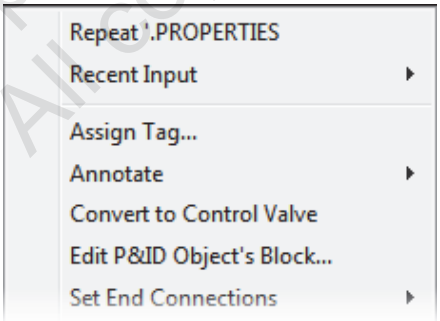
Refer to AutoCAD Plant 3D Help topics for a more comprehensive list and explanation of grips.

Examples of grips are shown in the following illustration.



Shortcut Menus

Right-clicking an object displays an item-specific menu, as shown in the following illustration. This menu has the standard AutoCAD items, as well as additional AutoCAD Plant 3D menu items relevant to the selected object. Because these menus vary based on the drawing type and item selected, you can use this menu as a shortcut to the menu item you need.



Sample provided by ASCENT for review only
All copying and reuse strictly forbidden

2D Grid and Snaps

It is strongly recommended that you use the standard grid/snaps in P&ID at all times. This assists in lining up items and making sure the layout is spread out and organized in a standard manner. If your P&ID is imperial, the industry standard snap spacing is 1/8". It can be helpful to first layout equipment on a 1/4" grid, and position text on a 1/16" grid. These options are available in the Status bar.

Object Snaps

While the use of object snaps is nothing new, one thing you might find different is that the node and near object snaps are enabled by default in the AutoCAD Plant 3D software. These object snaps are on by default because of their benefit in connecting a pipe to an existing one, connecting to nozzles, or positioning piping components on a pipe.

Sample provided by ASCENT for review only
All copying and reuse strictly forbidden

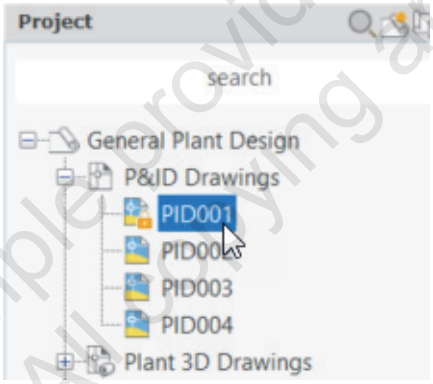
Exercise: Explore the User Interface

In this exercise, you explore the various commands that have been added to the AutoCAD software as part of the AutoCAD Plant 3D software. You examine tool palettes, ribbons, the Properties palette, and on-screen tools.

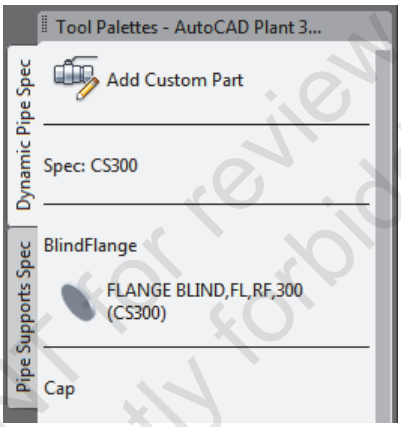
Tool Palettes and Ribbons

In this section of the exercise, you explore workspaces, tool palettes, and ribbons.

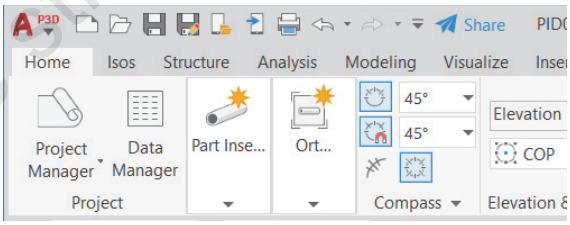
1. Start the AutoCAD Plant 3D software, if not already running.
2. Set General Plant Design as the current project as follows (if not already set):
   - In the Project Manager, Current Project list, click Open.
   - In the Open dialog box, navigate to the folder *C:\Plant Design2022 Practice Files\General Plant Design*.
   - Select the file *Project.xml*.
   - Click Open.
3. In the Project Manager, double-click on the PID001 drawing to open it (expand P&ID Drawings). One of the first things you note is the tool palette and ribbon layout.



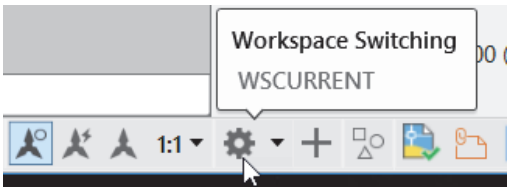
4. Examine the tool palette. Note that the AutoCAD Plant 3D software opens a workspace, tool palette, and ribbon for 3D design.



5. Examine the ribbon layout.

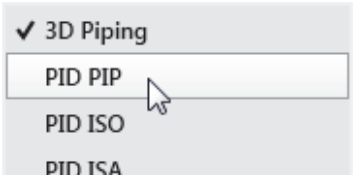


6. On the status bar, click Workspace Switching (on the arrow).



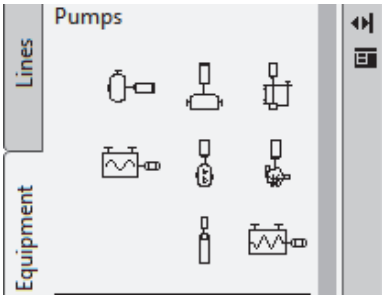
7. Select PID PIP, which is the P&ID PIP workspace.

Sample provided by ASCENT for review only
All copying and reuse strictly forbidden.



Alternatively, you can customize the Quick Access toolbar to display the Workspace drop-down list and use this to assign the Workspace.

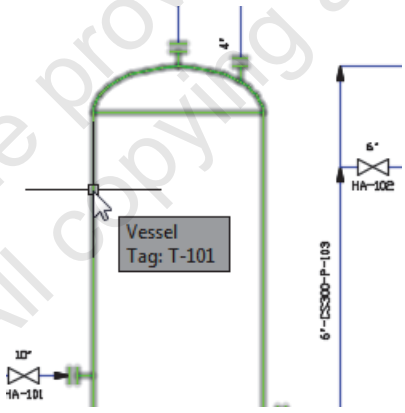
8. Examine the changes on the tool palette and ribbon.



Properties Palette

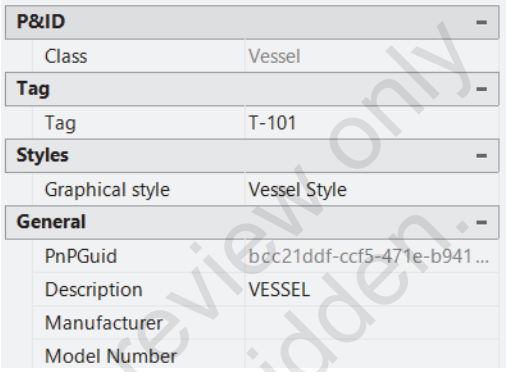
In this section of the exercise, you view data for objects in the Properties palette.

1. To open the Properties palette, in the drawing screen, double-click on the vessel as shown in the following illustration. (You can toggle off the drawing grid display in the Status bar.)



2. To dock the Properties palette, drag it to the side of the drawing window.

3. Examine the P&ID data that is specific to the vessel selected.



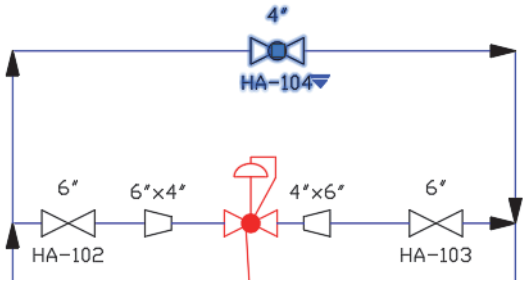
4. Select any other object in the drawing. Note that the data changes in the Properties palette to represent the object selected.

5. Press ESC to clear the selection.

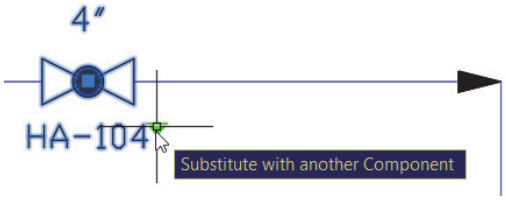
On-Screen Tools

In this section of the exercise, you explore various tools that you access directly on the drawing screen.

1. Select the 4" valve as shown in the following illustration. Note the custom grips.

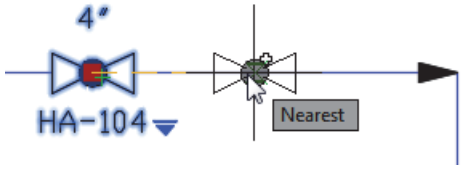


2. Hover over the grip (arrow grip) as shown in the following illustration. Note that you can substitute this valve with another component.

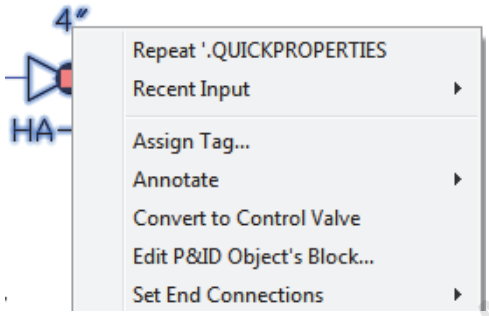


Sample provided by ASCENT for review only
All copying and reuse strictly forbidden.

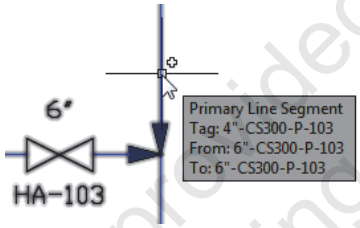
3. Use the Move grip (square grip in the center of the circle) to drag the valve to another location on the line. Select the new location. This breaks the line at the new location.



4. With the valve still selected, right-click and examine the P&ID-specific commands available on the context menu.



5. Hover over any object in the drawing to display a tooltip that provides information about that object.



6. Save and close the drawings.

Sample provided by ASCENT for review only
All copying and reuse strictly forbidden.

Lesson Review Questions

1. The AutoCAD Plant 3D software introduces a whole new interface to the AutoCAD software.
   a. True
   b. False
2. Tool palettes in the AutoCAD P&ID software and the AutoCAD Plant 3D software contain items specific to the workspace in which you are working.
   a. True
   b. False
3. Which of the following methods enables you to change the current Tool Palette that is active while remaining in the same Workspace?
   a. Right-click on the item and click Properties.
   b. Right-click on the Tool Palette header and click New Tool palette.
   c. Click the Workspace Switching command in the Status Bar and select a new tool palette.
   d. Select a Workspace from the Workspace drop-down in the Quick Access Toolbar.
4. What are the valid access points for commands and options for creating and editing objects in a drawing? (Select all that apply.)
   a. Properties palette
   b. Right-click shortcut menu
   c. Tool Palette
   d. Ribbon menu
5. Which of the following methods enables you to open the Properties Palette? (Select all that apply.)
   a. Double-click on the item.
   b. Right-click on the item and click Properties.
   c. Enter properties at the command prompt with or without an item selected.
   d. Right-click the drawing in the Project Manager and click Properties.

Sample provided by ASCENT for review only
All copying and reuse strictly forbidden.

Lesson: Managing Layers and Colors

Overview

Layers and colors are an important part of efficiently managing and interacting with the plant design geometry. This lesson describes the layer palette and project setup options regarding layers and colors. This lesson also explains the basic philosophy behind layering in a P&ID drawing, 3D model, and 2D orthographic and isometric drawings.

Objective

After completing this lesson, you will be able to:

- Describe how layers are managed.

Sample provided by ASCENT for review only
All copying and reuse strictly forbidden.

About Layers

Layers and colors in the AutoCAD Plant 3D software are organized using two separate methods:

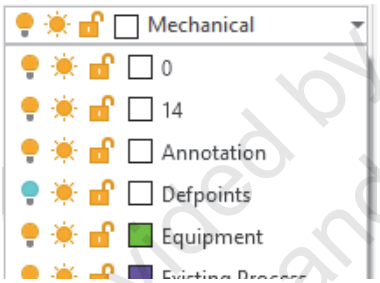
- 2D drawings use predefined layers in templates.
- 3D drawings can generate layers automatically during the design process based on automation schemes.

Regardless of layer organization, it is recommended that you set the color of items to ByLayer. This has several advantages including ensuring that objects of a particular color can be operated on by all the options in the Layer palette.

2D Drawing Layers - P&IDs, Orthographic, and Isometrics

Layers in a 2D drawing are most closely associated with the organization, editing, and output of the drawing into a final form, such as a DWF, PDF, or hard copy. This means that the various objects on the drawing are organized into layers associated with that general class of item. You use colors to distinguish between the various objects so that you can tell each object at a glance. Depending on the plotting options selected (ctb or stb) the color is also used to determine the line thickness of the object on the output selected.

For example, on a P&ID drawing, you organize the instrumentation onto an instrumentation layer, the piping onto a piping layer, annotation onto an annotation layer, etc., as shown in the following illustration. On an isometric drawing, the geometry might be on different layers based on the size of the pipe or fitting or other special characteristics.



Layers in the 3D Model Files

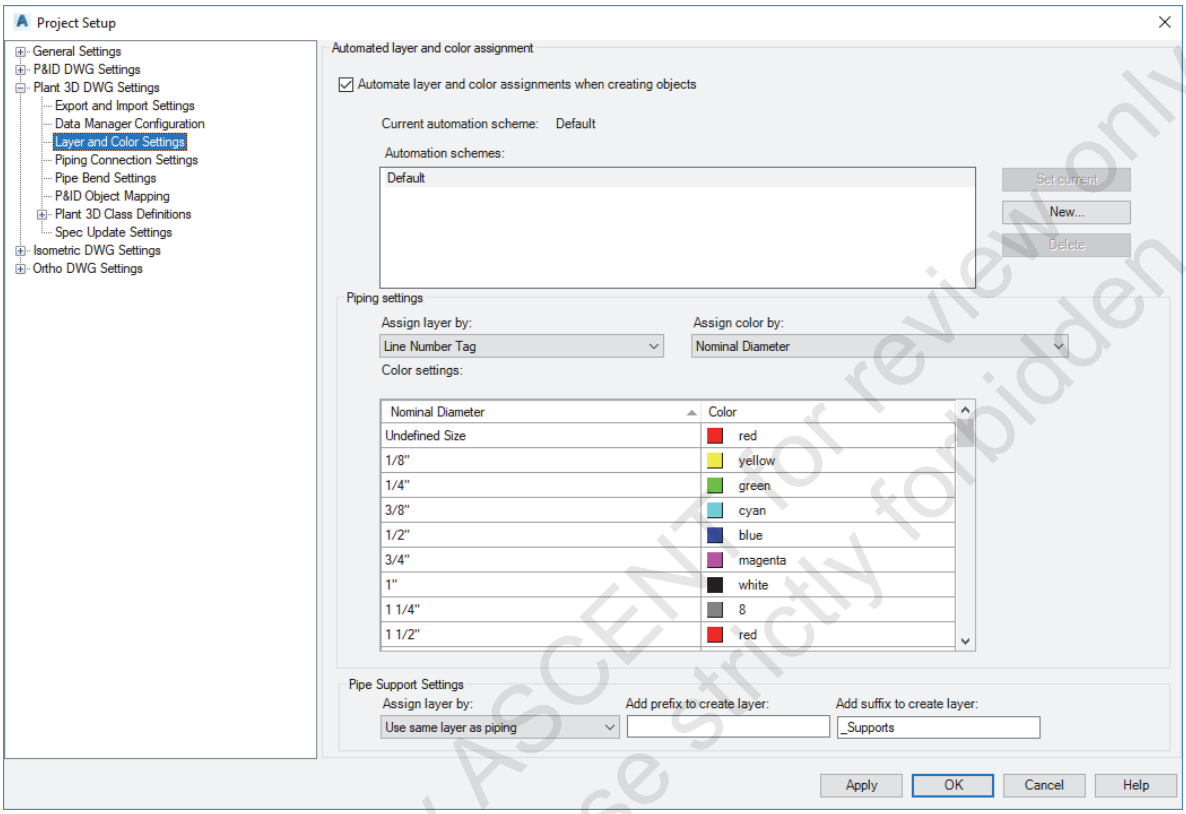
In a 3D model file, layers are used to organize the various items in the model into easily manageable groups. This enables you to manipulate the model during the design process and to select items, such as piping, steel, or equipment, as required. Because every project in 3D is different, there are fewer set standards for 3D.

Most companies have standards for how they want designers to use the layers in 3D. Typical layer organization in 3D might be as follows:

- Every piece of equipment is on its own layer, named after the equipment number.
- The various types of structural steel have their own layers (stairs, supports, handrails), unless they are associated with a piece of equipment, in which case they are on a layer named after the equipment with the structure type appended to it; for example, P-100A_Supports.
- Piping is a special case. You can set up an Automated Layer and Color Scheme depending on your company standards. This enables you to automate the layers on which the piping and other inline objects are placed to meet company standards. A typical standard for piping might be to have the layer set to the line number, and the color of the layer set to the service of the line.

Sample provided by ASCENT - for review only
All copying and reuse strictly forbidden

Access to the Layer and Color settings in the Project Setup dialog box is shown in the following illustration.



Sample provided by ASCENT for review only
All copying and reuse strictly forbidden.

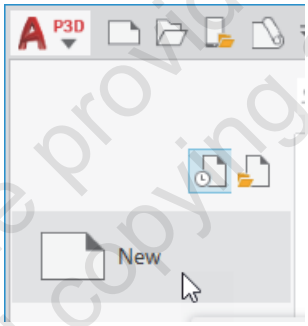
Exercise: Manage Layers and Colors

In the AutoCAD Plant 3D software, layers are used to both manage items and organize how the final drawings will be output. In this exercise, you explore the various areas that demonstrate where layers are set and used in an AutoCAD Plant 3D project.

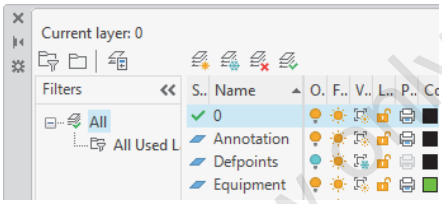
P&ID Layers

In this section of the exercise, you explore P&ID layers in a template.

1. Start the AutoCAD Plant 3D software, if not already running.
2. Set General Plant Design as the current project as follows (if not already set):
   - In the Project Manager, Current Project list, click Open.
   - In the Open dialog box, navigate to the folder *C:\Plant Design 2022 Practice Files\General Plant Design*.
   - Select the file *Project.xml*.
   - Click Open.
3. To open and examine the layers in a template drawing, click New in the Application Menu to create a new drawing using a template.



4. Select and open the *PID ISO A1 - Color Dependent Plot Styles.dwt* which is available with the software.
5. Open the Layers Properties Manager. Examine the layers that are in this template.

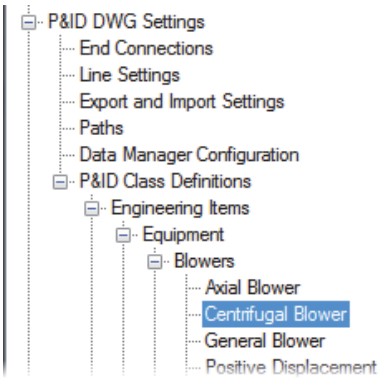


6. Close the new drawing an do not save if prompted.

P&ID Symbol Layer Management

In this section of the exercise, you explore how layers are used in P&ID symbol definitions.

1. In the Project Manager, right-click on the project name. Click Project Setup.
2. In the Project Setup dialog box, expand P&ID DWG Settings>P&ID Class Definitions> Engineering Items>Equipment>Blowers. Click Centrifugal Blower.



3. On the right hand pane of the dialog box, in Class settings: Centrifugal Blower, click Edit Symbol.
4. In the Symbol Settings dialog box, note that this symbol color is set to ByLayer, and the layer is set to Equipment.

General Style Properties	
Layer	Equipment
Color	☐ ByLayer
Linetype	——— ByBlock
Linetype Scale	---- Use Current ----
Plotstyle	ByColor
Line weight	---- Use Current ----

Sample provided by ASCENT for review only. All copying and reuse strictly forbidden.

5. Explore the settings for some of the other symbols.

6. Close all open dialog boxes without making any changes.

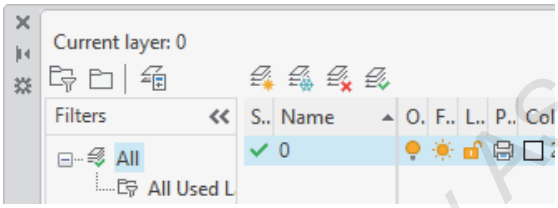
3D Layers

In this section of the exercise, you explore layer settings in a 3D template.

1. In the Application Menu, click New to create a new drawing using a template.

2. Select and open the *Plant 3D ISO - Color Dependent Plot Styles.dwt* which is available with the software.

3. Open the Layers Properties Manager. Note this template only has one layer with the name **0**.



4. Close the Layer Properties Manager.

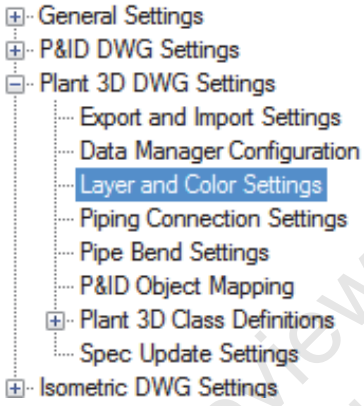
5. Close the new drawing.

3D Object Layer Management

In this section of the exercise, you explore how layers are used in 3D object definitions.

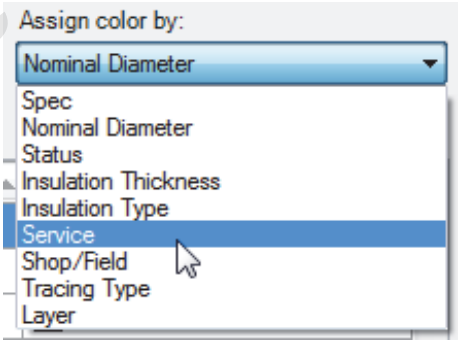
1. In the Project Manager, right-click on the project name. Click Project Setup.

2. In the Project Setup dialog box, expand Plant 3D DWG Settings. Select Layer and Color Settings.



3. In the Automated layer and color assignment section, examine the settings:
   - Automation schemes is set to Default.
   - Assign layer by is set to Line Number Tag.
   - Assign color by is set to Nominal Diameter.

4. Under Assign color by, select Service. Examine the changes that are made to the Color settings.



5. Use Cancel to close the Project Setup dialog box without saving the changes.

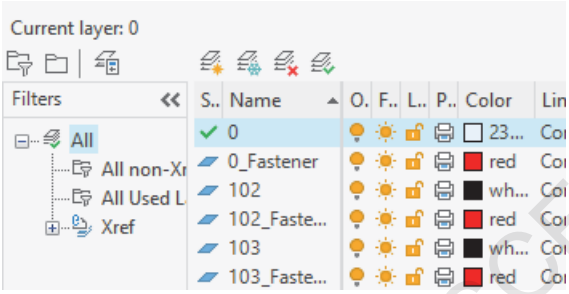
Sample provided by ASCENT for review only
All copying and reuse strictly forbidden.

3D Layers in a Drawing

In this section of the exercise, you open a 3D drawing and examine the layers that have been generated.

1. In the Project Manager, under Plant 3D Drawings, double-click on the Piping drawing to open it.

2. Open the Layer Properties Manager and examine the layers. If the layers are filtered and do not display, select All on the left pane, to display them.



3. Close the Layer Properties manager and close all the open drawings without saving.

Sample provided by ASCENT for review only
All copying and reuse strictly forbidden.

Lesson Review Questions

1. Layers in the 3D model are automatically assigned based on a property of objects being placed.
   a. True
   b. False
2. P&ID drawings can have a piping layer associated with each schematic line.
   a. True
   b. False
3. What is the recommended method for setting the color of AutoCAD P&ID and AutoCAD Plant 3D objects?
   a. ByLayer
   b. ByStandard
   c. ByObject
   d. ByBlock
4. Layer and color settings for P&ID drawings are configured the same way that layer and color settings are configured for Plant 3D drawings.
   a. True
   b. False

Sample provided by ASCENT for review only
All copying and reuse strictly forbidden.

Chapter Summary

In this chapter, you learned about many of the general topics for plant design and the use of the AutoCAD P&ID software and the AutoCAD Plant 3D software to create your plant designs.

Having completed this chapter, you can:

- Navigate the Project Manager and explain the purpose of a project and where the drawings and data are stored.
- Open drawings in the context of the project from the Project Manager.
- Identify the aspects of the user interface that are unique for plant design, and the workflow for creating and modifying a P&ID or 3D plant design.
- Explain the philosophy behind layering and explain the project setup options for layers and colors.

Sample provided by ASCENT for review only
All copying and reuse strictly forbidden.