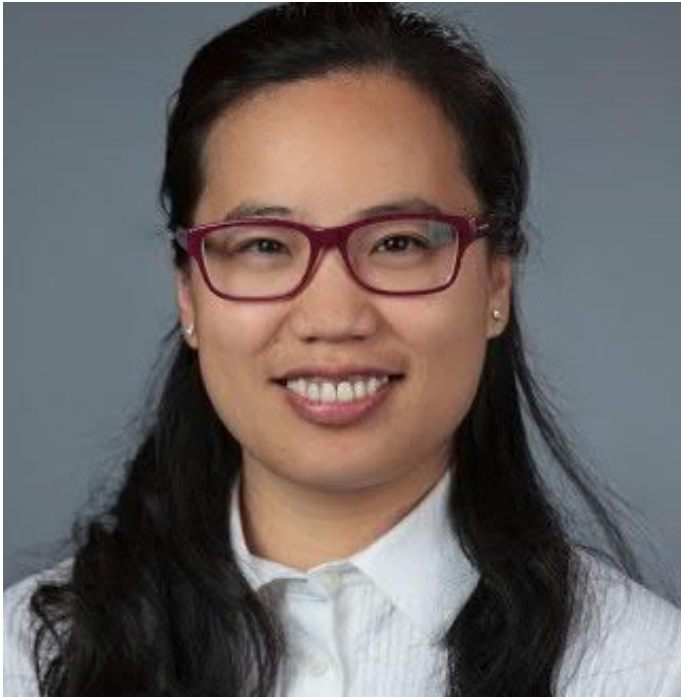


# Setup Plant 3D to Meet Your BIM Requirement

Peggy Lin, David Manning





## About the speaker

### Peggy Lin

- Digital Engineering Technology Specialist in AECOM ANZ, BIM manager /Digital Engineering Lead in major projects
- 15 years of working experience on Civil Infrastructure Projects
- Revit, Plant 3D, Civil 3D, inventor, Navisworks, Infraworks, Recap and 12D user
- Capable of programming in C#. Python and Dynamo
- Particular interest in developing workflow and methodology that interact with data directly and increase efficiency and productivity



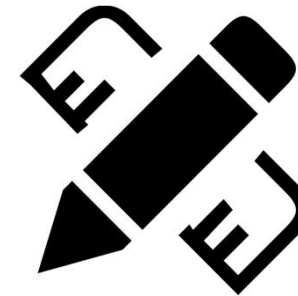
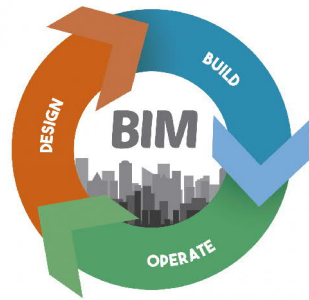
## About the speaker

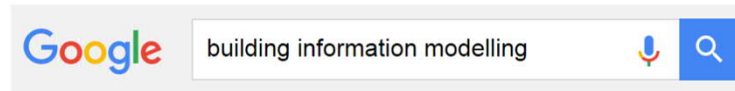
### David Manning

#### Designated Support Specialist

- Plant 3D and P&ID
- AutoCAD
- ReCap
- Recap Photo
- Navisworks
- Fusion 360
- Vault
- BIM 360 tools
- 6 years Steam Plant Design
- 12 Years Piping Design (Oil & Gas)
- 3 Years Autodesk Specialist

# Introduction





## WIKIPEDIA

Building information modelling (BIM) is a process supported by various tools, technologies and contracts involving the generation and management of digital representations of physical and functional characteristics of places.

## AUTODESK

Building Information Modelling is an intelligent 3D model-based process that gives architecture, engineering, and construction (AEC) professionals the insight and tools to more efficiently plan, design, construct, and manage buildings and infrastructure.

## NBS

BIM is a process for creating and managing information on a construction project across the project lifecycle. One of the key outputs of this process is the Building Information Model, the digital description of every aspect of the built asset. This model draws on information assembled collaboratively and updated at key stages of a project. Creating a digital Building Information Model enables those who interact with the building to optimize their actions, resulting in a greater whole life value for the asset.

# Digital Engineering

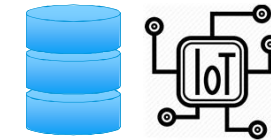


3D 'BIM' Model

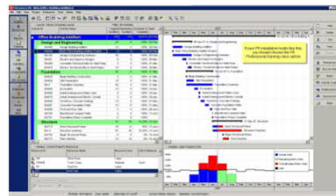
ID	Name	Location	Status
1	Asset 1	Location 1	Active
2	Asset 2	Location 2	Inactive
3	Asset 3	Location 3	Active
4	Asset 4	Location 4	Inactive
5	Asset 5	Location 5	Active
6	Asset 6	Location 6	Inactive
7	Asset 7	Location 7	Active
8	Asset 8	Location 8	Inactive
9	Asset 9	Location 9	Active
10	Asset 10	Location 10	Inactive

Asset Data

6D BIM



Other Data

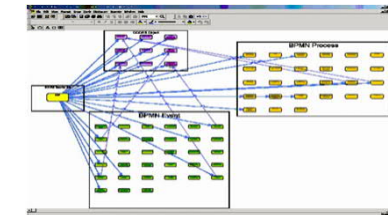


Time

4D BIM



2D/3D GIS



Requirements Mgmt

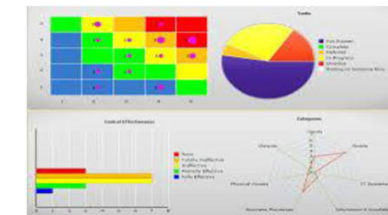
Item	Quantity	Unit	Price	Total
1	100	m	100	10000
2	50	m	200	10000
3	20	m	500	10000
4	10	m	1000	10000
5	5	m	2000	10000
6	2	m	5000	10000
7	1	m	10000	10000
8	0.5	m	20000	10000
9	0.2	m	50000	10000
10	0.1	m	100000	10000

Cost

5D BIM

Document	Version	Author	Created	Modified
1	1.0	John Doe	2019-11-21	2019-11-21
2	1.1	Jane Smith	2019-11-20	2019-11-20
3	1.2	Mike Johnson	2019-11-19	2019-11-19
4	1.3	Sarah Lee	2019-11-18	2019-11-18
5	1.4	David Brown	2019-11-17	2019-11-17
6	1.5	Emily White	2019-11-16	2019-11-16
7	1.6	Chris Black	2019-11-15	2019-11-15
8	1.7	Alex Green	2019-11-14	2019-11-14
9	1.8	Olivia Grey	2019-11-13	2019-11-13
10	1.9	Noah Blue	2019-11-12	2019-11-12

Document Mgmt



Risk Mgmt

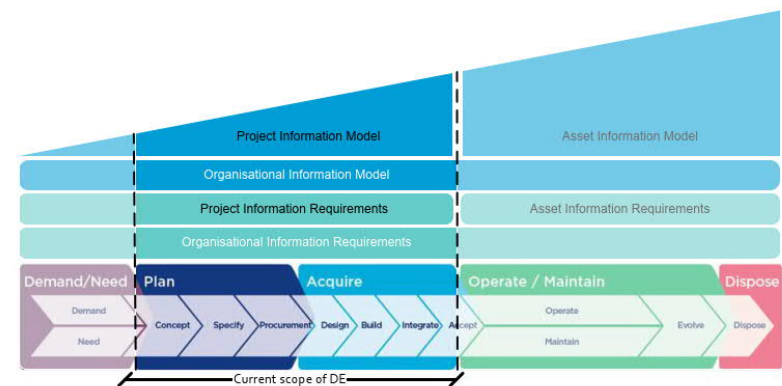
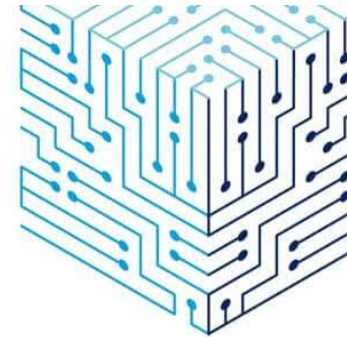
Source: TfNSW DE Framework

# Digital Engineering

- Collaborative way of working
- Using digital processes
- Asset creation, construction and O&M

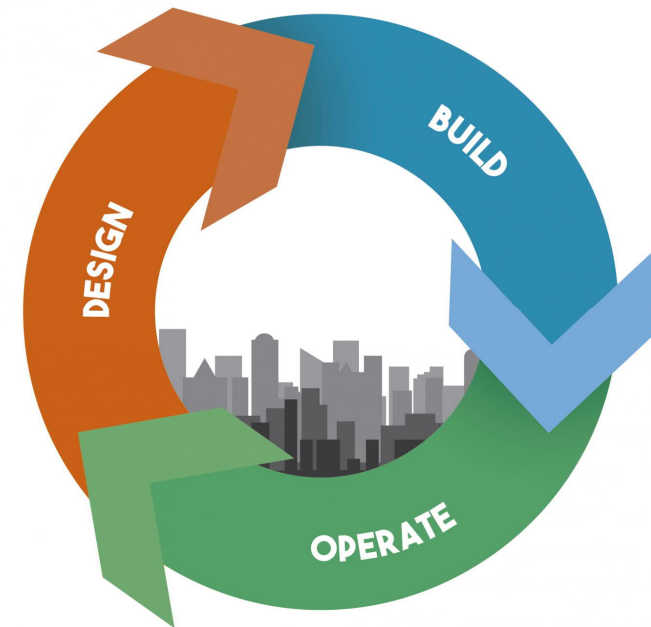


## Digital Engineering Framework



## Benefits of BIM/DE

- Coordination
- Communication
- Data management
- Analysis and Simulation
- Improved working methods during design
- Improved Productivity during construction
- Better information for facility management

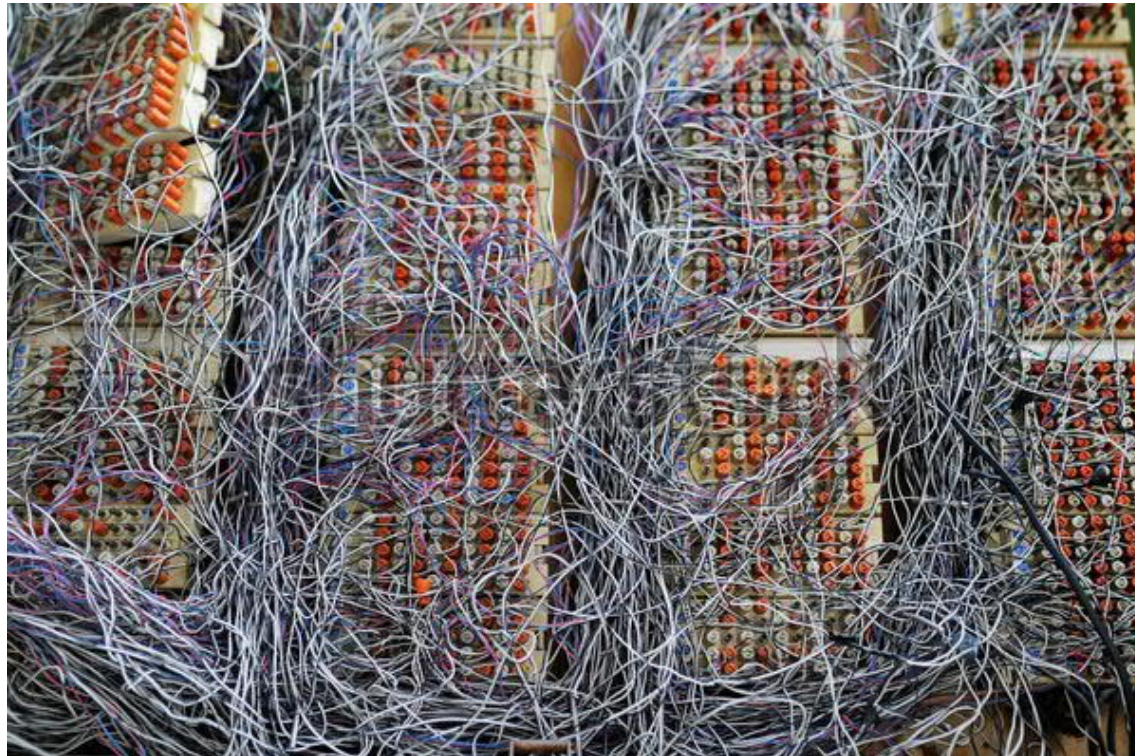


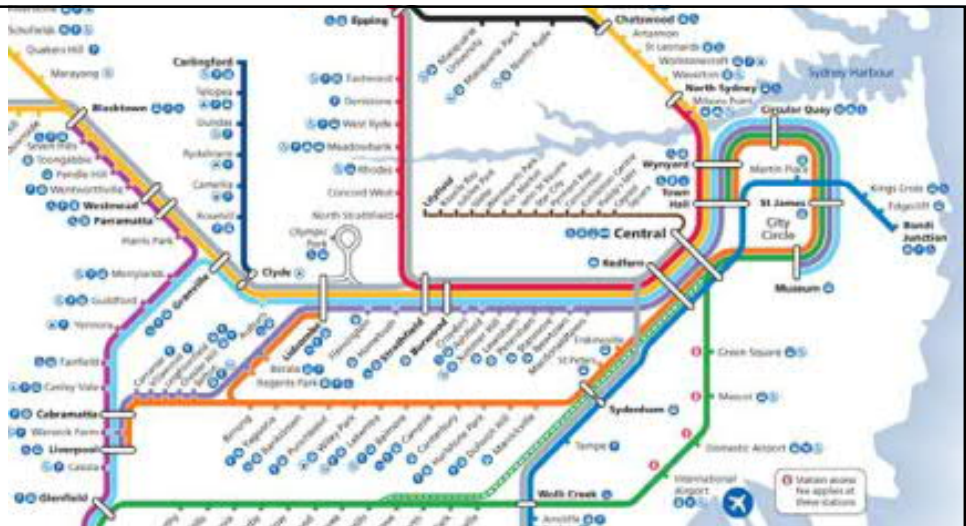


# Information is the oil of the 21<sup>st</sup> century, and analytics is the combustion engine.

Peter Sondergaard, Gartner Research







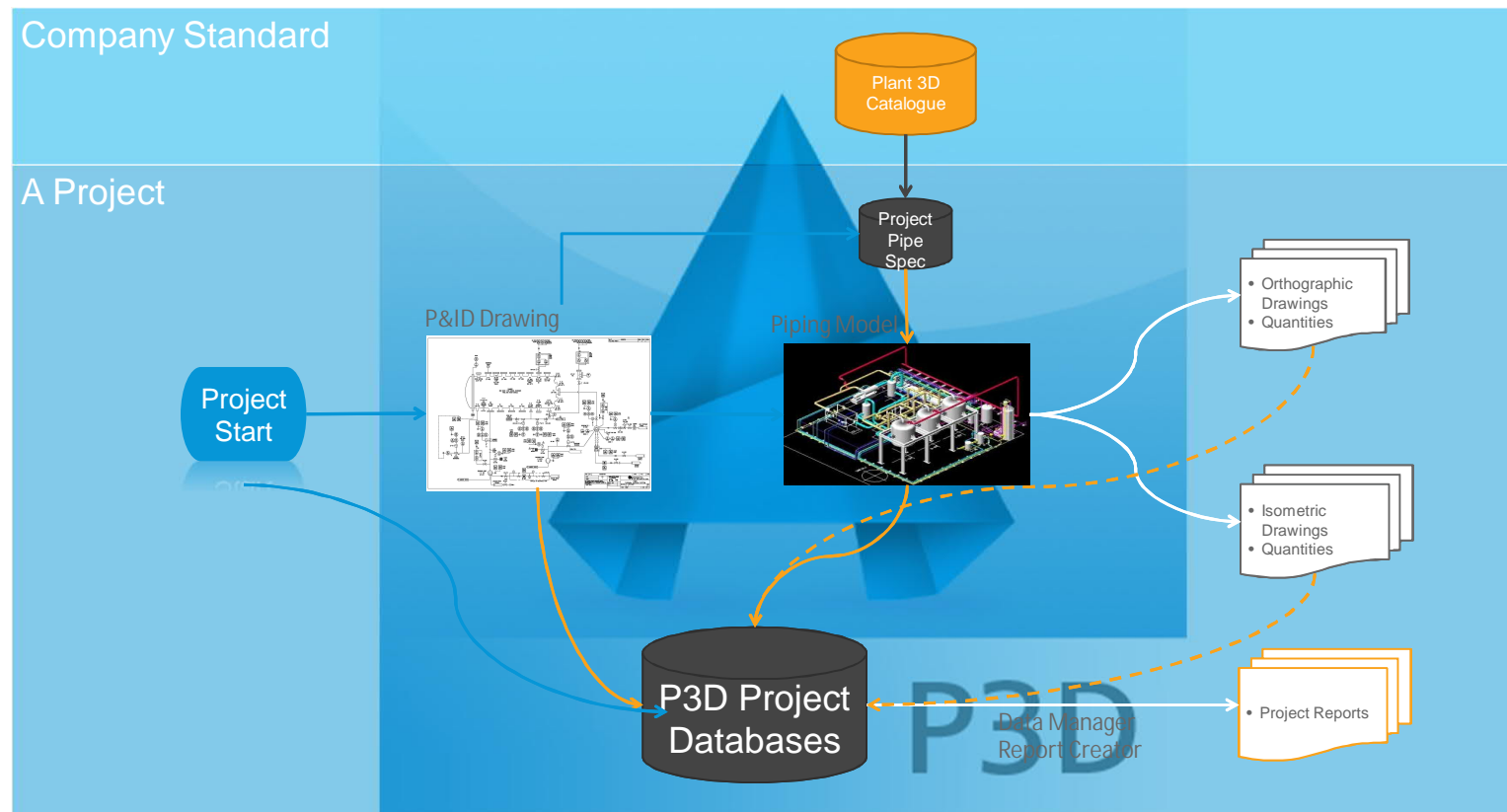
# Location Referencing

- Address
- A unique code or label

# Plant 3D Overview



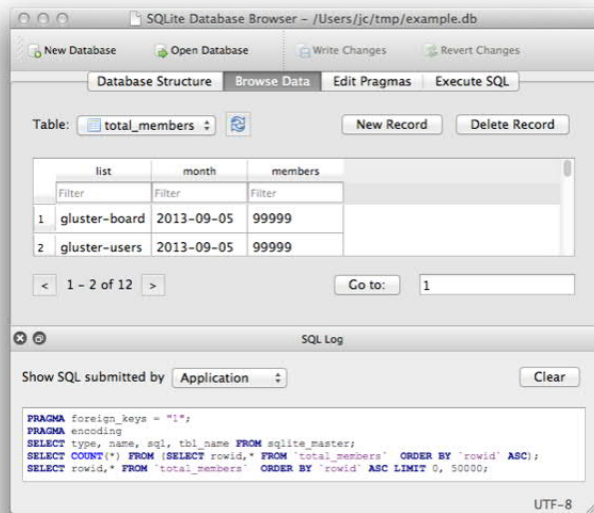
# Plant 3D Overview





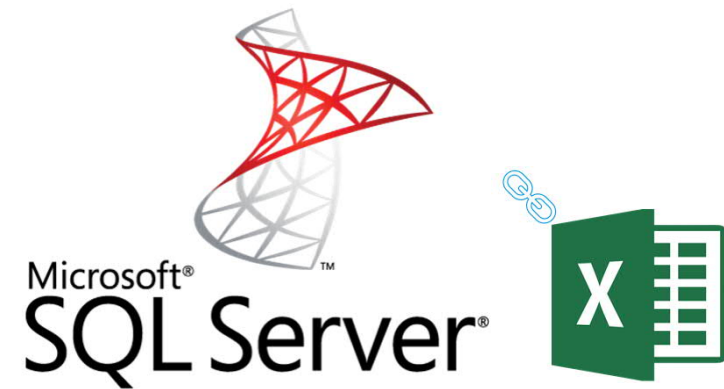
# Plant 3D Database

<https://sqlitebrowser.org/>  
**DB Browser for SQLite**



- Fast indexing
- Support 1-2 users to read/write in the same time

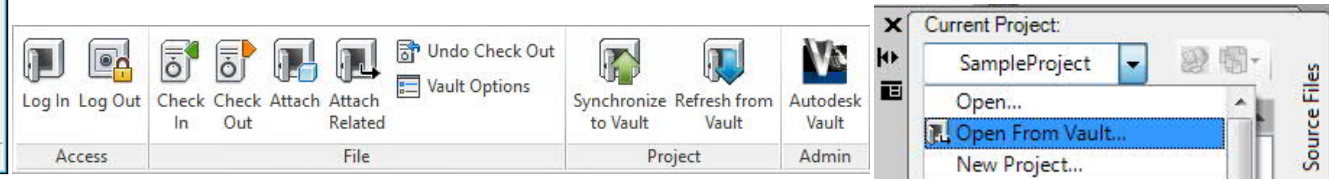
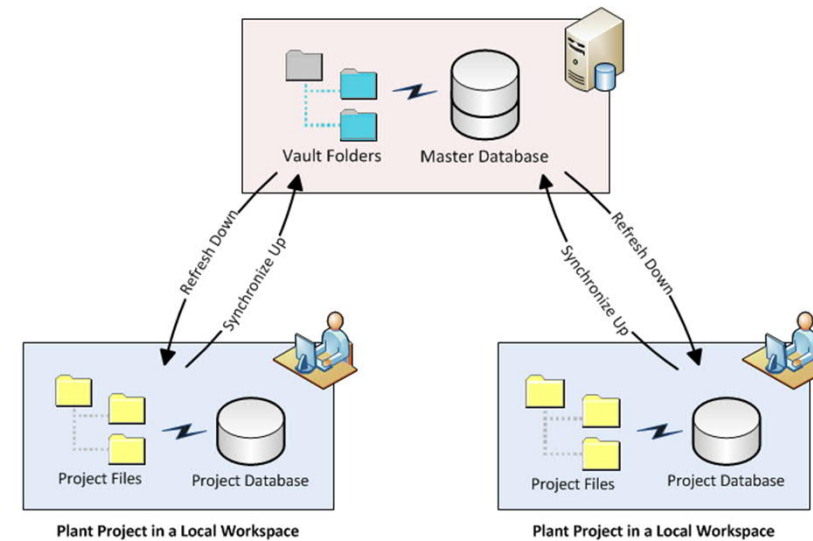
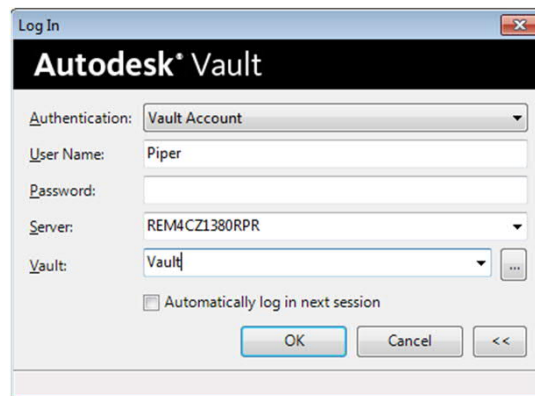
Reference: [SQLite: The database at the edge of the network](#)



- Relational database
- Run on sever, user control
- Support many users to read/write at the same time

# Plant 3D Collaboration - Autodesk Vault

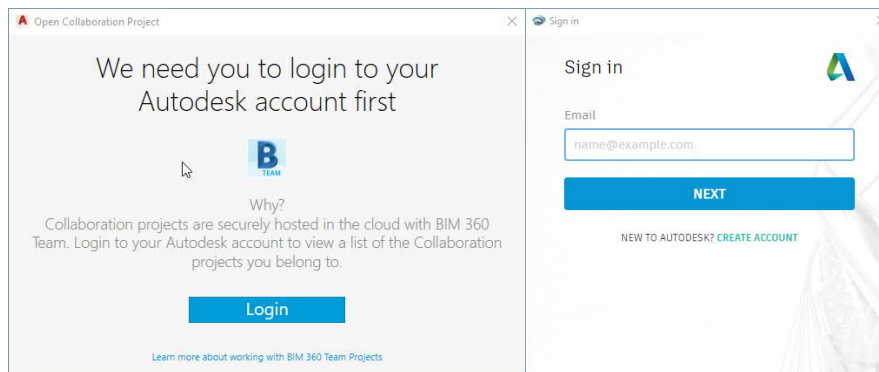
- Local workspace
- check-in and check-out document management
- Automatic file version
- Master project database
- User authentication and access control



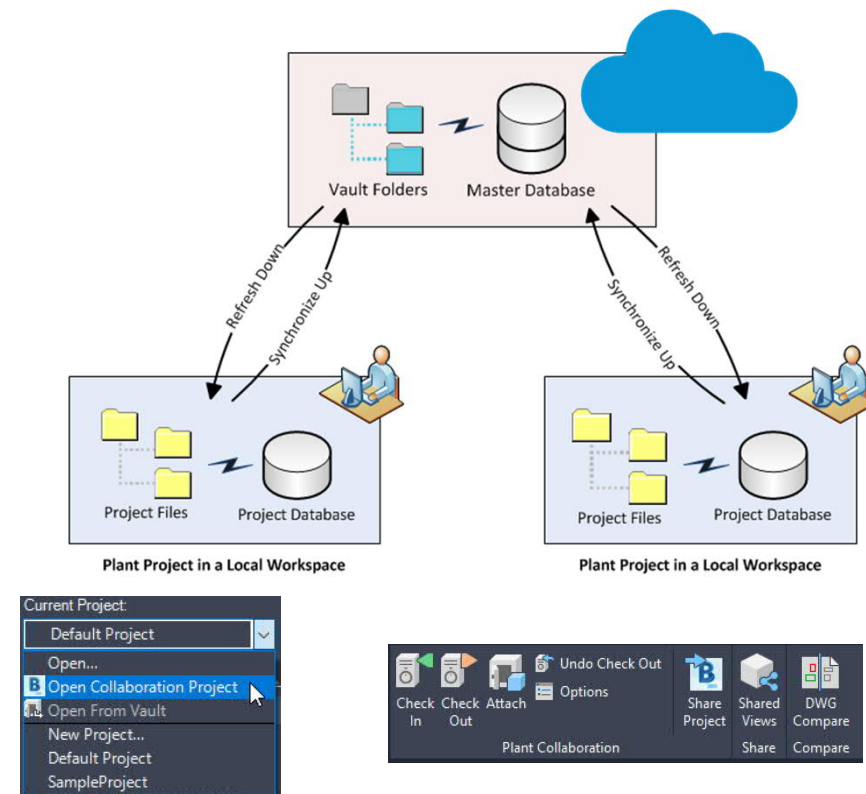
Reference: [About Autodesk Vault](#)

# Plant 3D Collaboration – BIM360 TEAM

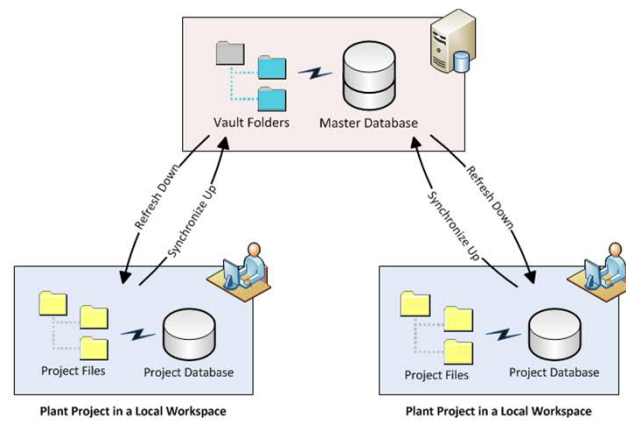
- Local workspace
- check-in and check-out document management
- Automatic file version
- Master project database
- User authentication and access control



Reference: [About Autodesk Vault](#)

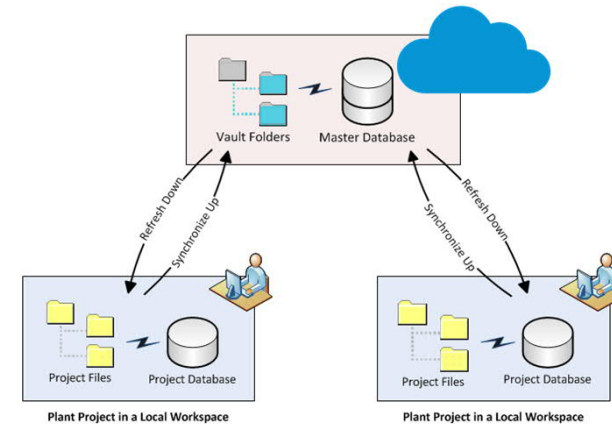






## Autodesk Vault

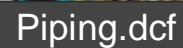
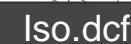
- Data sovereignty
- Cost and time on set up servers



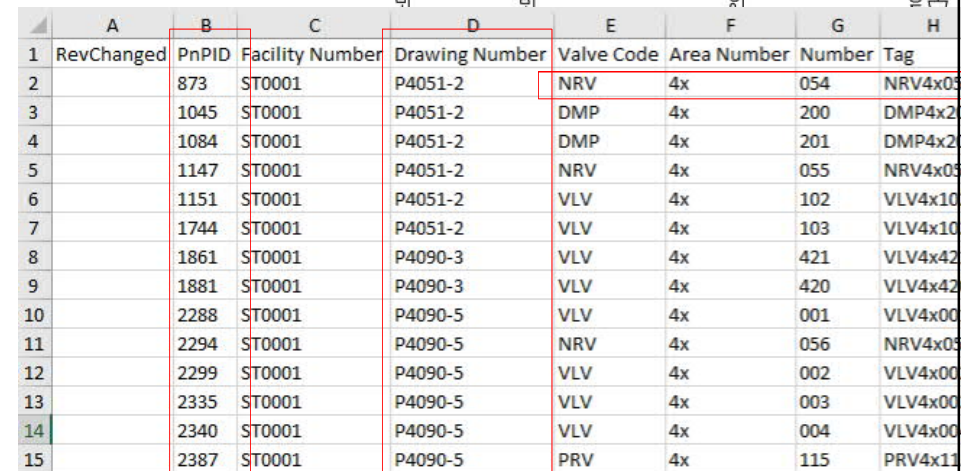
## BIM360 TEAM

- Low cost
- Easy to setup
- Use (Amazon Web Services) AWS, main server in US

# Plant 3D modules

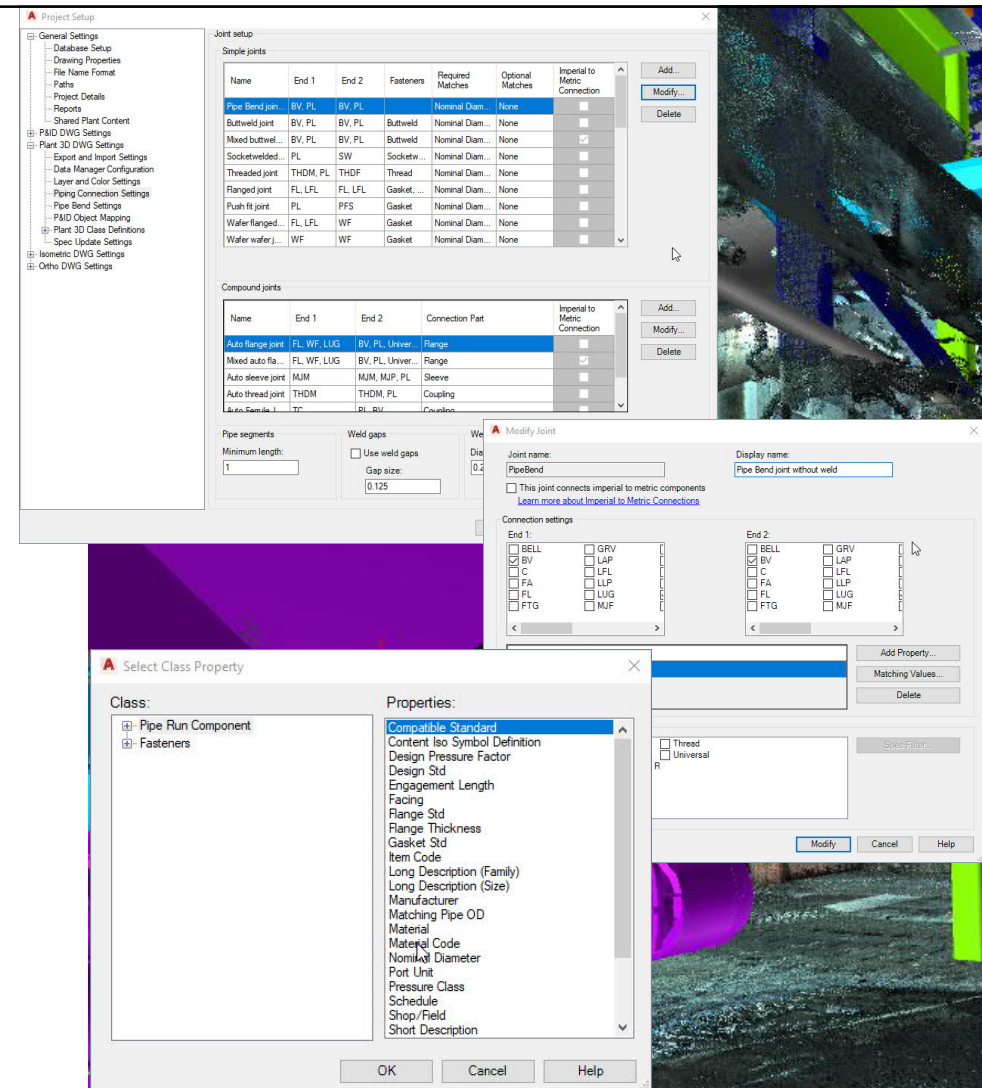


- Data saved in database as P&ID drawings created;
- Each graphic element presents a object class, and has set of properties
- All annotation come from class properties and useful not only present the data but also provide a way to visually check data
- Easy schedule and data update
- Validation with Plant 3D model



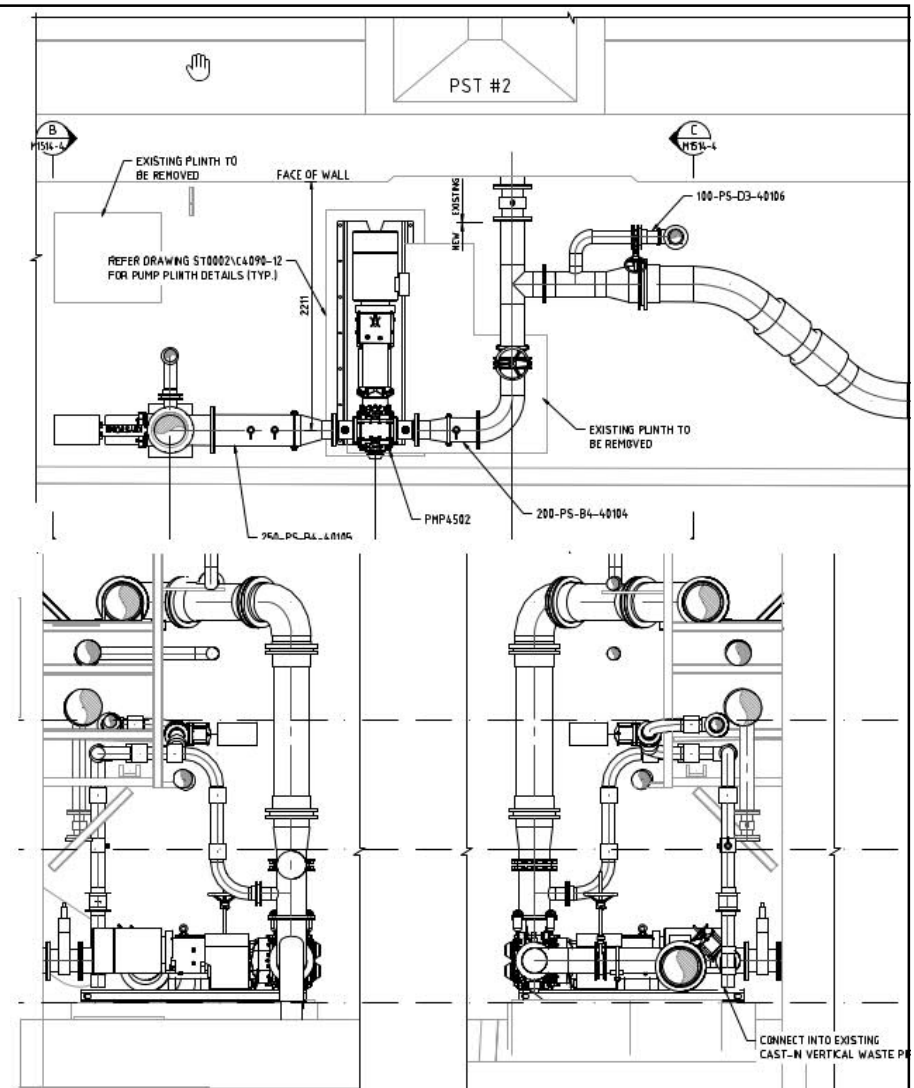
# 3D Modelling

- Spec driven, auto-routing
- Configurable branch table
- Customize to any level of rule enhancement as required
- Easily add, delete parameters
- Support sloping modelling

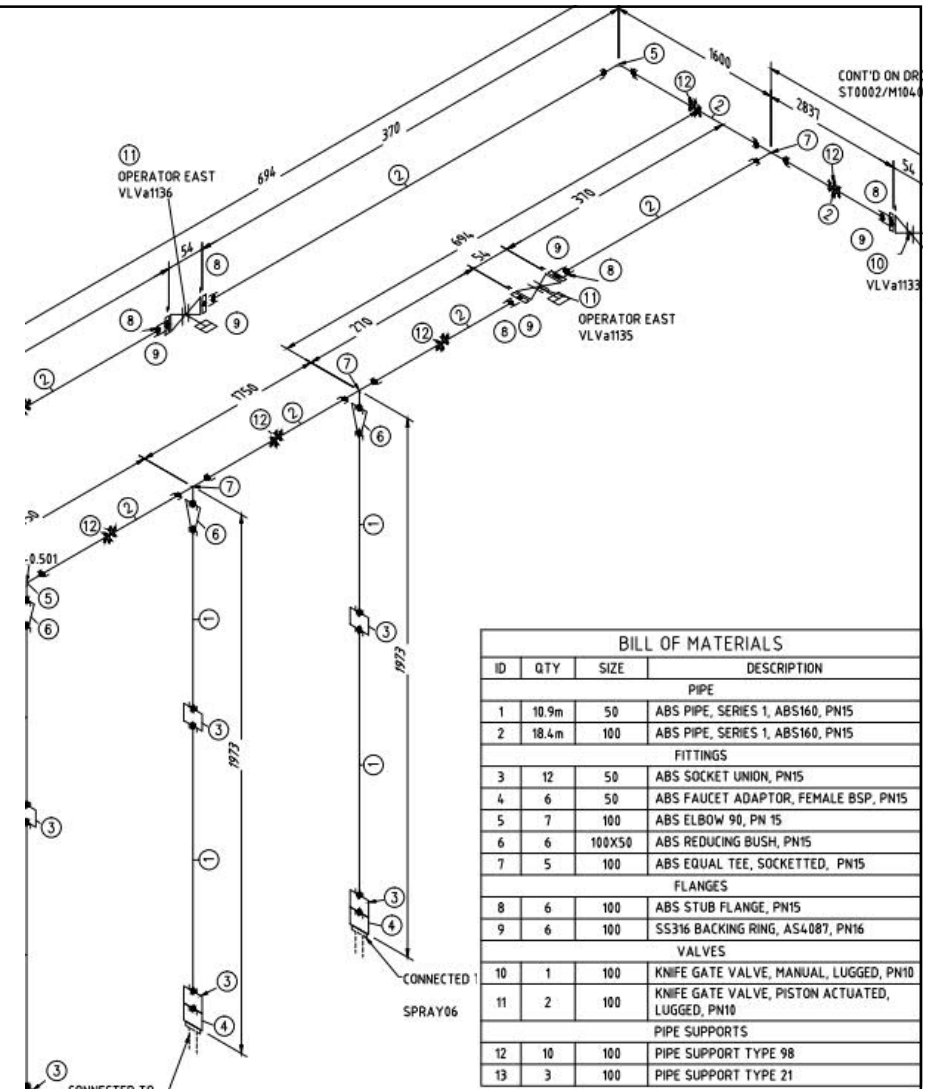


# Orthographic Drawings

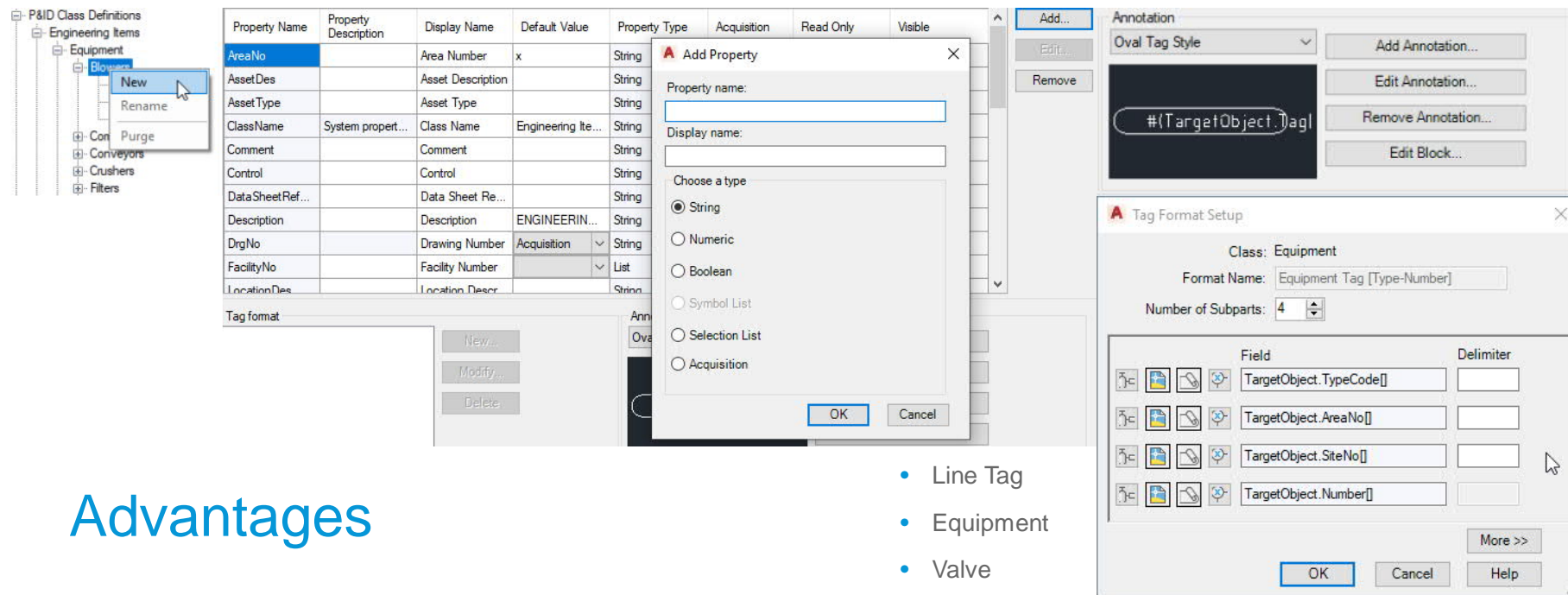
- Layer control
- Annotation from model properties
- Cut and slide anywhere
- BOM



- Generated from model without manual editing
- BOM auto generation per line
- Enable off site construction
- Configuration customisable







## Advantages

- Data Structure and object classification
- Smart annotation
- Standardize the look and feel across all drawings using project level tagging/annotation customization
- Tag concatenation
- Line Tag
- Equipment
- Valve
- Instruments



## Limitations

- DWG /AutoCAD based
- Data verification is not in its best
- Navisworks out model only contain limited data

### 3D Model to P&ID checks

- ☐ Tagged inline items are in a 3D model but not in a P&ID drawing
- ☐ Tagged inline items are in a P&ID drawing but not in a 3D model
- ☐ Items have the same tag in 3D models and P&ID drawings, but do not have matching types
- ☐ Properties have different values in P&ID drawings and 3D models
- ☐ Inline items are on different lines in P&ID drawings and 3D models
- ☐ Equipment in a 3D model has more nozzles than it does in a P&ID drawing
- ☐ Equipment in a 3D model has fewer nozzles than it does in a P&ID drawing

Current project: SWC\_RDC\_De...

☒ VLV9352  
☒ VLV93C6  
☒ FTX9362  
☒ VLV93A8  
☒ VLV93C7  
☒ STN9360  
☒ VLV93B8  
☒ MIX9360  
☒ VLV93B5

☐ Don't display errors marked as ignored

**Details**

Error Type	P&ID error: This item ...
Error action	<Unassigned>

This Valve (?-INLINE) with tag VLV93A8 was found as a Valve\_KnifeGate in the P&ID drawing ST0014\_P4051-3.dwg.

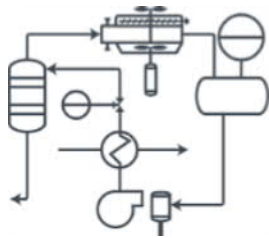
 A 3D model of a valve assembly, showing a vertical pipe with a valve handle and various fittings.



# Plant 3D Customization



### P&ID Module



- SubstitutionPalettes.xml



PIDTo3dClassMapping.xml

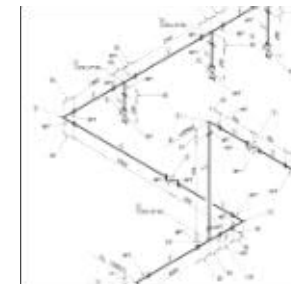
### 3D Modelling Module



- DefaultConnectorsConfig.xml
- ProjectSetupSpecUpdateSettings.xml



### Isometric Module



- BoltSizeMappings.xml
- IsoSkeyAcadBlockMap.xml
- IsoSymbolStyles.dwg
- Plant3dIsoSymbols.dwg
- IsoConfig.xml
- Iso.dwt

# XML



- XML stands for Extensible Markup Language
- Is a markup language much like HTML
- Was designed to store and transport data
- Was designed to be self-descriptive
- Open standard
- Text file
- Data storage

```
<?xml version="1.0" encoding="UTF-8"?>
<Project xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
  <ProjectName>Project1</ProjectName>
  <ProjectDescription>
  </ProjectDescription>
  <ProjectVersion>92</ProjectVersion>
  <ProjectVersionMinor>0</ProjectVersionMinor>
  <ProjectParts>
    <ProjectPart name="PnId" fileName="C:\Users\LinP3\Documents\Project1\PIP_Metric_PnIdPart.xml" relativeFileName="PIP_Metric_PnIdPart.xml" uncFileName="" />
    <ProjectPart name="Piping" fileName="C:\Users\LinP3\Documents\Project1\Metric_PipingPart.xml" relativeFileName="Metric_PipingPart.xml" uncFileName="" />
    <ProjectPart name="Iso" fileName="C:\Users\LinP3\Documents\Project1\IsoPart.xml" relativeFileName="IsoPart.xml" uncFileName="" />
    <ProjectPart name="Ortho" fileName="C:\Users\LinP3\Documents\Project1\Metric_OrthoPart.xml" relativeFileName="Metric_OrthoPart.xml" uncFileName="" />
    <ProjectPart name="Misc" fileName="C:\Users\LinP3\Documents\Project1\MiscPart.xml" relativeFileName="MiscPart.xml" uncFileName="" />
  </ProjectParts>
  <ProjectPartDirectories>
    <ProjectPartDirectory name="SpecSheets" directoryName="C:\Users\LinP3\Documents\Project1\Spec Sheets" relativeDirectoryName="Spec Sheets" uncDirectoryName="" />
    <ProjectPartDirectory name="Ortho" directoryName="C:\Users\LinP3\Documents\Project1\Orthos\DWGs" relativeDirectoryName="Orthos\DWGs" uncDirectoryName="" />
    <ProjectPartDirectory name="Related Files" directoryName="C:\Users\LinP3\Documents\Project1\Related Files" relativeDirectoryName="Related Files" uncDirectoryName="" />
  </ProjectPartDirectories>
</Project>
```

# P&ID Customization

- **Inheritance**
- Should setup tags for all annotation need in drawings
- Understand the output required before modify class definitions
- Not all class is schedulable

## P&ID Class Definitions

### Engineering Items

- + Equipment
- + Inline Assets
- + Instrumentation
- + Lines
- + Nozzles

### Non Engineering Items

- + Actuators
- ... Annotation
- ... Closed Drain No PID
- + Connectors
- ... Flag
- ... Flow Arrow
- ... Gap
- + Line Breakers
- ... Open Drain No PID
- ... Tie In

... Pipe Line Group

... Signal Line Group

- P&ID drawings
- Equipment
- Instrument
- Line
- Nozzle
- Specialty Items
- Valve
- Control Valve

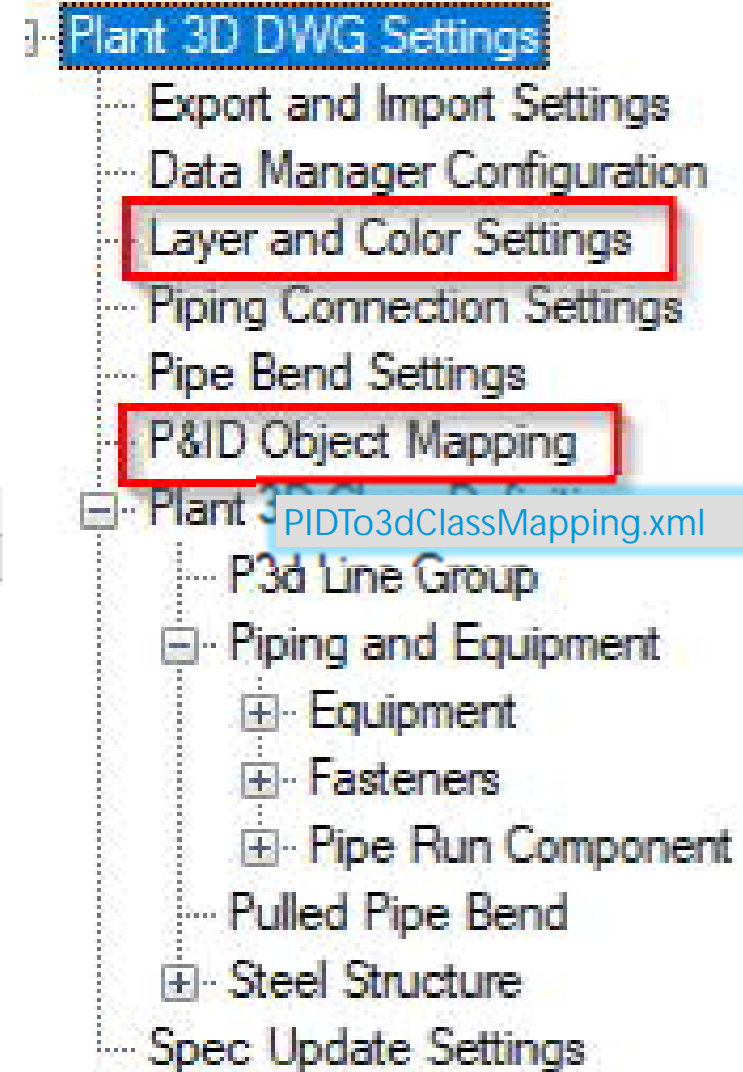
## Plant 3D Modelling Customization

- Layer and color settings
- P&ID Object Mapping
- Pipe Number Setting

Assign layer by:	Assign color by:
Line Number Tag	Layer



[Tailoring AutoCAD P&ID and AutoCAD Plant 3D](#)



# Isometric Customization

The image shows the 'Project Setup' dialog box in AutoCAD Plant 3D, specifically the 'Isometric DWG Settings' tab. The left sidebar lists various settings categories, with 'Isometric DWG Settings' highlighted. The main area contains several sections for customization:

- Check\_A2**: A dropdown menu with a '+' button and a checkbox for 'Spool format'.
- Drawing format**: Includes checkboxes for 'Place field welds at maximum pipe lengths' (unchecked) and 'Add pipe makeup length to BOM for Field Fit Welds' (checked). It also has input fields for 'Maximum pipe length' (0.00 mm) and 'Makeup Length' (50.00 mm).
- Table overflow**: A section for 'To continue long tables:' with radio buttons for 'Use a blank sheet' (unchecked) and 'Split the drawing' (checked).
- File naming**: Includes a 'Prefix' field with '%Line Number%', a 'Sample' field with '1', and an 'Add property' dropdown set to 'Line Number'.
- Spool naming**: Includes a 'Spool naming' dropdown set to 'Line-Numeric (101-1)'.
- Spools**: Includes a 'Sizing method' dropdown set to 'Automatic (Max. size)' and input fields for 'Length' (2000.00 mm), 'Width' (6000.00 mm), and 'Height' (2000.00 mm).
- Content paths**: Includes input fields for 'Iso Style files directory', 'Production iso output directory', and 'Quick iso output directory', all pointing to 'C:\Users\LinP3\Documents\Project 1\Isome'.

At the bottom of the dialog are 'Apply', 'OK', 'Cancel', and 'Help' buttons.

To the right of the dialog is a file explorer window showing the project structure: 'This PC > Documents > Project1 > Isometric > Check\_A2'. The files listed are: 'ClientConfig.isf', 'Iso.atr', 'Iso.dwt', 'IsoConfig.xml' (highlighted with a red box), and 'IsoCreationLog.txt'.

De-mystifying AutoCAD Plant 3D Isometrics



# Catalogue Creation

Autodesk AutoCAD Plant 3D Catalog Builder (C:\ProgramData\Autodesk\Autodesk AutoCAD Plant 3D 2018\R22.0\...

Home

New Open Save Save As New Duplicate Delete Property Editor Export to Excel Catalog Build Settings Help

Autodesk AutoCAD Plant 3D Spec Editor 2018

File Edit Specs Catalogs Tools Help

General Properties Sizes

Preview

Sizes	Shape Name	ID	LL	B	D	FNO	BNO	BDA	BTY	L1	D1	L2	D2	L3	D3	I1	I2	ContentGen	PartFamilyId	SizeRecordId_S-ALL
40	PS_013_JDSM	43.434	187	18	150	1	4	16	1	93.5	49.565	0	0	0	0	0	0	ID,LL,B,D,F	00935ad9-827d-4427-87cb-699a24a8ea48	dac485cb-3358-48a3-976b-ac49db2362cc
50	PS_013_JDSM	54.2925	194	17	165	1	4	16	1	97	56.33125	0	0	0	0	0	0	ID,LL,B,D,F	00935ad9-827d-4427-87cb-699a24a8ea48	a7feb0fd-781c-4b04-a4f6-4405c1a961a5
80	PS_013_JDSM	80.01	194	17	200	1	4	16	1	97	72.225	0	0	0	0	0	0	ID,LL,B,D,F	00935ad9-827d-4427-87cb-699a24a8ea48	1ab9f767-0a3a-4a04-bdd5-9fc705a4eb16
100	PS_013_JDSM	102.87	194	25	235	1	4	20	1	97	87.325	0	0	0	0	0	0	ID,LL,B,D,F	00935ad9-827d-4427-87cb-699a24a8ea48	7d4ebd81-2936-4667-aacf-13420eee88ad
125	PS_013_JDSM	127.15875	194	25	270	1	4	24	1	97	102.821875	0	0	0	0	0	0	ID,LL,B,D,F	00935ad9-827d-4427-87cb-699a24a8ea48	b0f4a879-8b25-4c89-b1c3-cafb7511e9c1
150	PS_013_JDSM	151.4475	194	25	300	1	4	24	1	97	117.06875	0	0	0	0	0	0	ID,LL,B,D,F	00935ad9-827d-4427-87cb-699a24a8ea48	c4dee55e-5c09-4957-9669-c80d3034165c
200	PS_013_JDSM	197.1675	194	25	375	1	4	27	1	97	148.51875	0	0	0	0	0	0	ID,LL,B,D,F	00935ad9-827d-4427-87cb-699a24a8ea48	1503eaca-4468-4456-a2ec-c39c8aebf4b9
250	PS_013_JDSM	245.745	194	25	450	1	4	30	1	97	180.7625	0	0	0	0	0	0	ID,LL,B,D,F	00935ad9-827d-4427-87cb-699a24a8ea48	24f9c21b-ed9a-42a7-b21f-ef383bc5e538
300	PS_013_JDSM	291.465	194	25	515	1	4	30	1	97	209.7125	0	0	0	0	0	0	ID,LL,B,D,F	00935ad9-827d-4427-87cb-699a24a8ea48	1436c83b-cec8-4133-b0d7-2b8d43763e75
350	PS_013_JDSM	320.04	307	25	580	1	4	33	1	153.5	233.9	0	0	0	0	0	0	ID,LL,B,D,F	00935ad9-827d-4427-87cb-699a24a8ea48	9887021b-37c5-4ca6-82c8-9c4964890054
400	PS_013_JDSM	365.76	307	25	660	1	4	36	1	153.5	266.6	0	0	0	0	0	0	ID,LL,B,D,F	00935ad9-827d-4427-87cb-699a24a8ea48	6000404c-1cb0-493b-a439-4c1da972e9c8
450	PS_013_JDSM	411.48	307	25	685	1	5	36	1	153.5	285.55	0	0	0	0	0	0	ID,LL,B,D,F	00935ad9-827d-4427-87cb-699a24a8ea48	0c8622fa-3c1b-4347-863f-35e5a78bd88d
500	PS_013_JDSM	457.2	307	25	755	1	5	39	1	153.5	315.75	0	0	0	0	0	0	ID,LL,B,D,F	00935ad9-827d-4427-87cb-699a24a8ea48	d344a93f-04f5-4729-8302-4f52e792e3d1
550	PS_013_JDSM	502.92	320	38	835	1	5	45	1	160	348.45	0	0	0	0	0	0	ID,LL,B,D,F	00935ad9-827d-4427-87cb-699a24a8ea48	b7d7b92b-096d-46c1-8862-c7b4e5a2dc19
600	PS_013_JDSM	548.64	320	38	890	1	5	45	1	160	374.9	0	0	0	0	0	0	ID,LL,B,D,F	00935ad9-827d-4427-87cb-699a24a8ea48	cae53030-4c4c-423a-ad3f-f0fd0936fbae
650	PS_013_JDSM	594.36	320	38	945	1	6	45	1	160	401.35	0	0	0	0	0	0	ID,LL,B,D,F	00935ad9-827d-4427-87cb-699a24a8ea48	090e4886-c708-4e98-a0b9-da3b58e55d0f
700	PS_013_JDSM	640.08	320	38	995	1	6	45	1	160	426.55	0	0	0	0	0	0	ID,LL,B,D,F	00935ad9-827d-4427-87cb-699a24a8ea48	5ef8742b-5876-4502-8132-117f0f86e6be
800	PS_013_JDSM	731.52	320	38	1140	1	6	52	1	160	488.2	0	0	0	0	0	0	ID,LL,B,D,F	00935ad9-827d-4427-87cb-699a24a8ea48	d19de6f6-588d-4d6e-a2b4-c416dcc53853
900	PS_013_JDSM	822.96	320	38	1250	1	7	52	1	160	541.1	0	0	0	0	0	0	ID,LL,B,D,F	00935ad9-827d-4427-87cb-699a24a8ea48	e7324441-78df-42ee-95b5-c16ca10ec83d
1000	PS_013_JDSM	914.4	320	38	1360	1	8	52	1	160	594	0	0	0	0	0	0	ID,LL,B,D,F	00935ad9-827d-4427-87cb-699a24a8ea48	2637d960-7062-45ab-8a73-db8ea4ed6792
1200	PS_013_JDSM	1097.28	320	38	1575	1	10	56	1	160	698.55	0	0	0	0	0	0	ID,LL,B,D,F	00935ad9-827d-4427-87cb-699a24a8ea48	1719e53b-1fe5-4910-bbe4-7c0f6005dcdf
1400	PS_013_JDSM	1280.16	462	60	1795	1	14	56	1	231	804.35	0	0	0	0	0	0	ID,LL,B,D,F	00935ad9-827d-4427-87cb-699a24a8ea48	1a7ae46d-3963-4d6b-841f-f29f8cd8d899
1600	PS_013_JDSM	1463.04	462	60	2025	1	14	64	1	231	912.65	0	0	0	0	0	0	ID,LL,B,D,F	00935ad9-827d-4427-87cb-699a24a8ea48	905badc9-5c31-48ec-a022-32ed6a5fc08b

Piping Component Editor

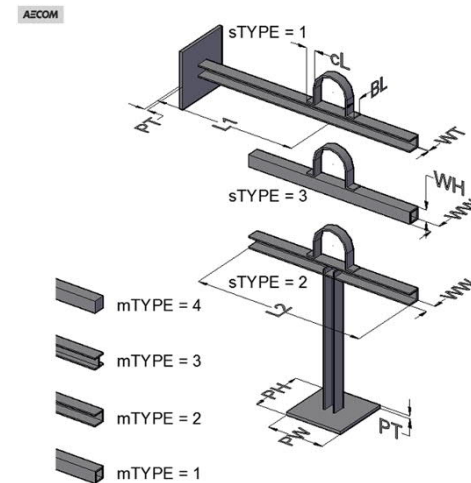
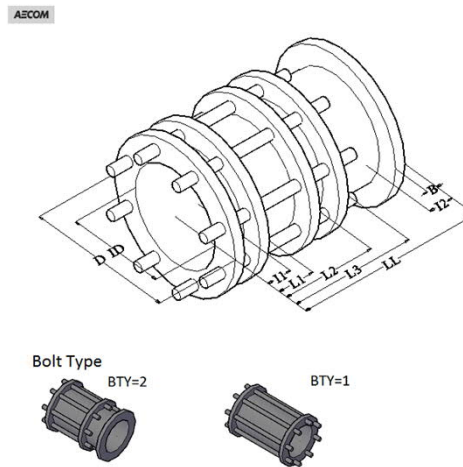
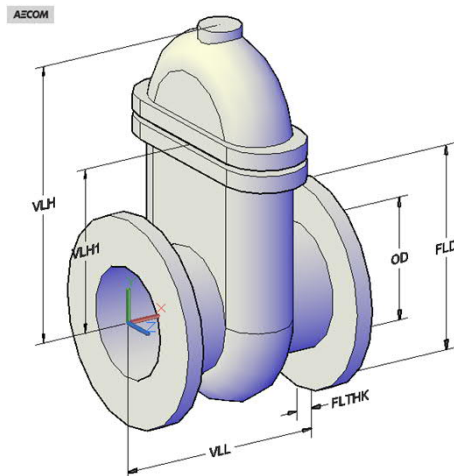
225x200 DN225x200...  
250x100 DN250x100...  
250x150 DN250x150...  
250x200 DN250x200...

Hide Advanced Editing Table

Miscellaneous  
Olets  
Pipes  
Valves & Operators  
Instruments

Total Part Families: 0

Save to Catalog



## Python Scripted parts

### Advantage over block

- Good look and feel
- Simple and productive



[Custom Python Scripts for AutoCAD Plant 3D – Part 1](#)  
[Custom Python Scripts for AutoCAD Plant 3D – Part 2](#)  
[Custom Python Scripts for AutoCAD Plant 3D – Part 3](#)

	Actuator Create Type			
Valve Body	Catalogue Standard	Catalogue Block	Catalogue Python	3D Block
Catalogue Standard	Yes	Yes		Yes
Catalogue block		Yes		Yes
Catalogue Python		Yes		
Custom Standard	Yes			Yes
Custom block				





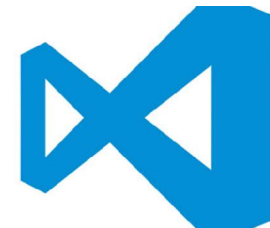
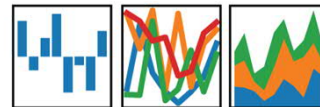
## Python

- Popular object-oriented language
- Easy to read
- Run as it is being compiled

matplotlib



pandas  
 $y_i t = \beta' x_{it} + \mu_i + \epsilon_{it}$



```

## create by Peggy Lin (Peggy.lin@aecom.com/Peggy.lin.sydney@gmail.com) @24.01.2016
## tested in Plant 3D 2018

from aqa.math import *
from varmain.primitive import *
from varmain.var_basic import *
from varmain.custom import *

@activate(Group="Valvebody", TooltipShort="GATE Valve", TooltipLong="GATE Valve", LengthUnit="mm", FirstPortEndtypes="FL", Ports=2)
@group("MainDimensions")
@param(VLL=LENGTH, TooltipShort="Length of Valve", TooltipLong="Length of Valve")
@param(FLTHK=LENGTH, TooltipShort="Thickness of the valve flange", TooltipLong="Thickness of the valve flange")
@param(FLD=LENGTH, TooltipShort="OD of Valve Flange", TooltipLong="OD of Valve Flange")
@param(OD=LENGTH, TooltipShort="OD of pipe", TooltipLong="OD of Pipe")
@param(VLH=LENGTH, TooltipShort="H of Valve", TooltipLong="H of Valve")
@param(VLH1=LENGTH, TooltipShort="H of Valve", TooltipLong="H of Valve")

def PS_004_VGAT(s, VLL=100, FLTHK=10, FLD=10, OD=10, VLH=10, VLH1=10, adH=20.0, FLgap=3.0):
    ob1=CYLINDER(s, R=OD/2.0, H=VLH1)
    ob2=CYLINDER(s, R=FLD/2.0, H=FLTHK)
    ob1.uniteWith(ob2)
    ob2.erase()

    ob2=CYLINDER(s, R=FLD/2.0, H=FLTHK)
    ob1.uniteWith(ob2)
    ob2.erase()

    ob2=TORUS(s, R1=OD/2.0, R2=VLL/2.0, H=VLH)
    ob1.uniteWith(ob2)
    ob2.erase()

    ob2=CYLINDER(s, R=OD/2.0, H=VLH)
    ob1.uniteWith(ob2)
    ob2.erase()

    ob4=BOX(s, L=OD*1.2, W=FLTHK, H=VLL/3.0*1.2).translate((0,0,VLH1+FLTHK/2.0+FLgap))
    ob1.uniteWith(ob4)
    ob4.erase()

    ob4=CYLINDER(s, R=VLL/6.0*1.2, H=FLTHK, O=0.0).translate((0,OD*1.2/2.0,VLH1+FLgap))
    ob1.uniteWith(ob4)
    ob4.erase()

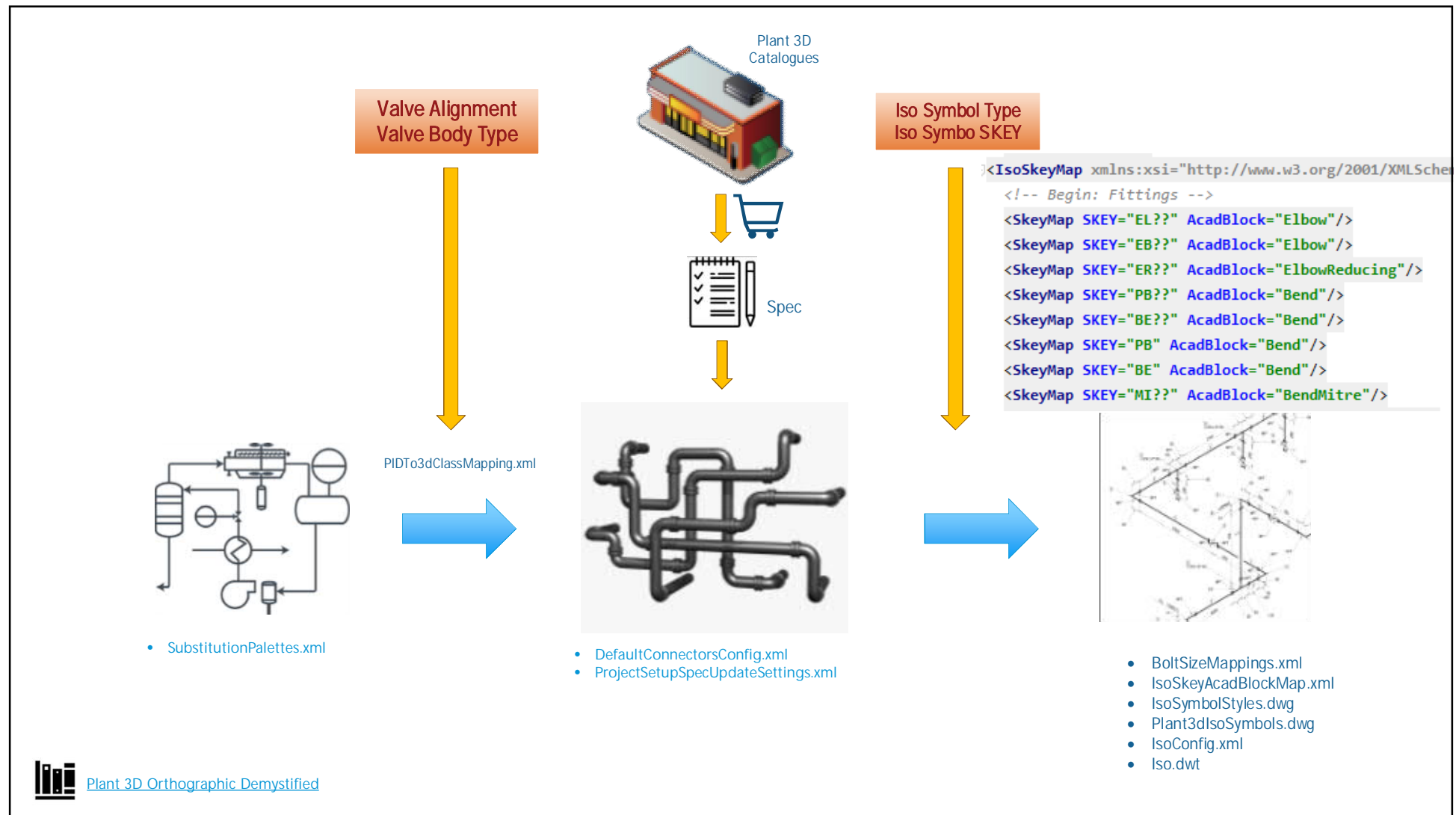
    ob4=CYLINDER(s, R=VLL/6.0*1.2, H=FLTHK, O=0.0).translate((0,-OD*1.2/2.0,VLH1+FLgap))
    ob1.uniteWith(ob4)
    ob4.erase()

    if OD > VLL:
        ob4=CYLINDER(s, R=VLL/6.0, H=VLH, O=0.0)
    else:
        ob4=CYLINDER(s, R=OD/6.0, H=VLH, O=0.0)
    ob1.uniteWith(ob4)
    ob4.erase()

    ob5=CYLINDER(s, R=OD*0.45, H=VLL, O=0.0).rotateZ(-90).rotateY(90).translate((-VLL/2.0,0,0))
    ob1.subtractFrom(ob5)
    ob5.erase()

    s.setPoint((-VLL/2.0,0,0), (-1,0,0))
    s.setPoint((VLL/2.0,0,0), (1,0,0))

```



# Plant 3D Setup for BIM/DE



## Employer Information Requirement

- Sets out the information required by the employer, enabling suppliers to produce a BIM execution plan or Digital Engineering execution plan;
- Defines what the employer wants to get out of the project information model at each stage.
  - Who is sharing the information? – outline responsibility matrix
  - What Information is needed – Detailed Information Requirements
  - When information is needed by? Project milestones
  - Why the information is needed? Defined information purpose

## Custom Properties

### Satisfy Asset Information Requirement

- Add custom properties to object class
- Have a coding system
- Add to catalogue
- Add to project

Class settings: Pipe Run Component

Symbol

No preview available

Properties

Property Name	Property Description	Display Name	Default Value	Property Type	Acquisition	Read Only	Visible in Area View	Visible in Object View
*WarrantyExpiry		Warranty ...		String	None	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
*WBS_Level1		WBS Leve...	LSCT	String	None	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
*WBS_Level2		WBS Leve...	ST0011	String	None	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
*WBS_Level3		WBS Leve...	Acquisi... ▼	String	Drawing....	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
*WBS_Level4		WBS Leve...	M	String	None	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
*WBS_Level5		WBS Leve...	731	String	None	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
*WBS_Level7		WBS Leve...		String	None	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
*Weight		Weight		String	None	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
*Weight Unit		Weight Unit		String	None	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
BOP		Bottom of ...		String	None	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
BOP Meter		BOP Meter		String	None	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
COP Meter		COP Meter		String	None	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
COP_meter		COP_meter		String	None	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Effective_Length		Effective_...		Number	None	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Fluid		Fluid	▼	List	None	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Add... Edit... Remove

Properties						
Item	AutoCad	Entity Handle	TimeLiner	Material		
Property					Value	
Entity Transparency					ByLayer	
Material					ByLayer	
Class					Pipe	
PnPGuid					21087e5c-62df-450a-8d48-ef27e1f11921	
Long Description					PIPE, SCH 10S, BE	
Plant Material					SS	
Schedule					10	
Size					100	
Status					New	
End Type					PL	
Spec					B4	
Service					DS	
Line Number					100-DS-B4-7747	
Length					550	

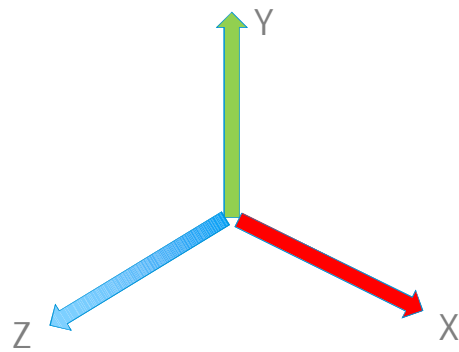
Item	DWF - Generic Properties	DWF - Pipe	TimeLiner	Material
Property				Value
BOP				25118.487
BOP Meter				25.118
COG X				247922.750
COG Y				-2135.774
COG Z				25202.625
COP Meter				25.202625
ContentIsoSymbo...				TYPE=PIPE,SKEY=PIPE
CutLength				6000.000
EndType				PL
EngagementLen...				0.000
ItemCode				A112015
Length				6000.000
LengthUnit				mm
LineNumberTag				150-SL-B4-216
LinearWeightUnit				KG/M
MatchingPipeOd				168.275
Material				SS
NominalDiameter				150.000
P&ID DrawingNu...				P4024-2
PartFamilyLongD...				PIPE, SCH 10S, BE
PartSizeLongDesc				DN150, PIPE, SCH 10S, BE
Position X				247666.828
Position Y				853.291
Position Z				25202.625
Schedule				10
Service				SL
Shop_Field				SHOP
ShortDescription				Pipe, Seamless
Site ID				ST0011
Size				150
Spec				B4
Status				New
TOP				25286.763
Top Meter				25.287
UseFixedLength				False
WBS Level 1				LSCT
WBS Level 2				ST0011
WBS Level 3				4024
WBS Level 4				M
WBS Level 5				731
WBS Level 6				A112015
WBS Level 7				0004295
Weight				0.000
WeightUnit				KG

Nwc out data output

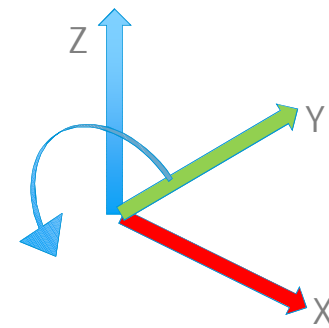
Dwf data output

## Present model with custom data

Export model as 3D dwf



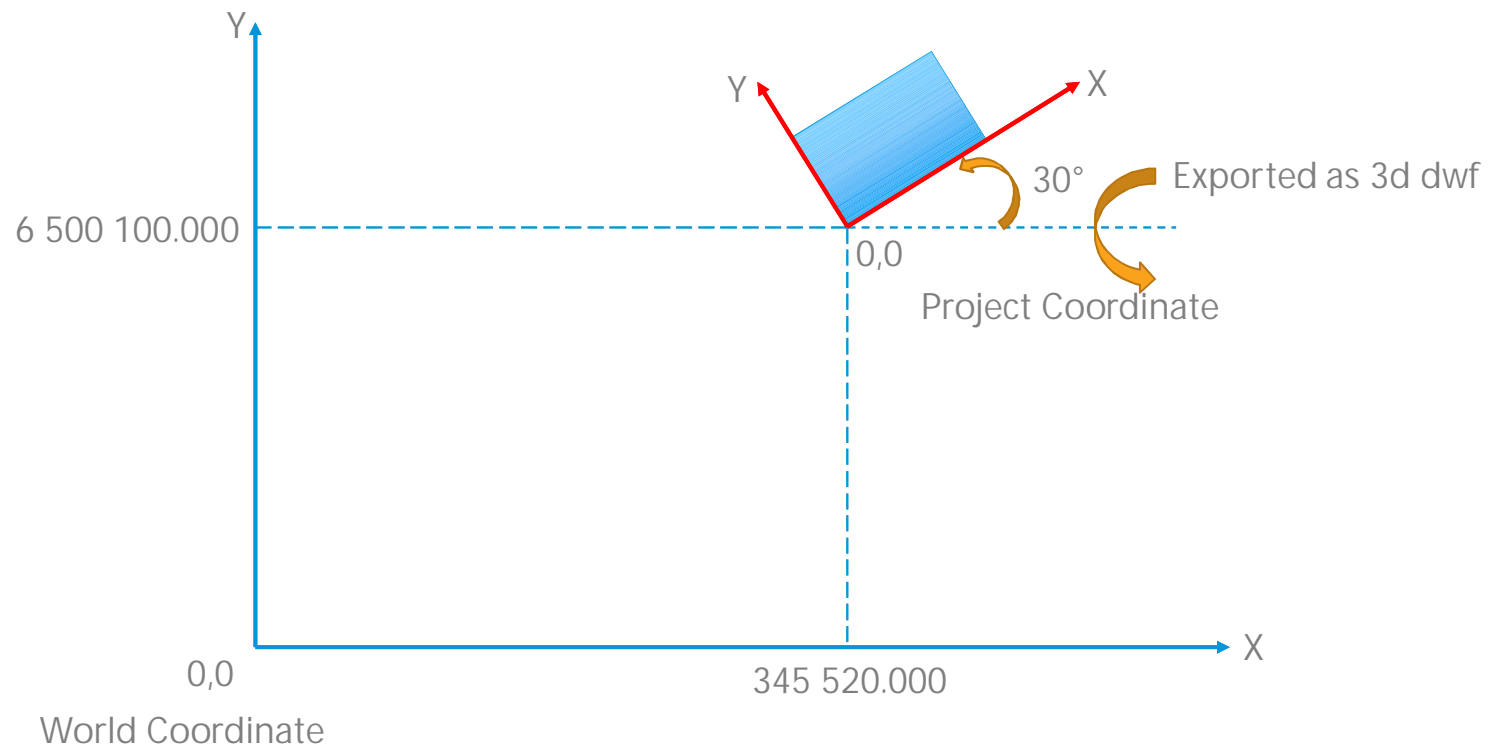
Inventor and Dwf file Axis



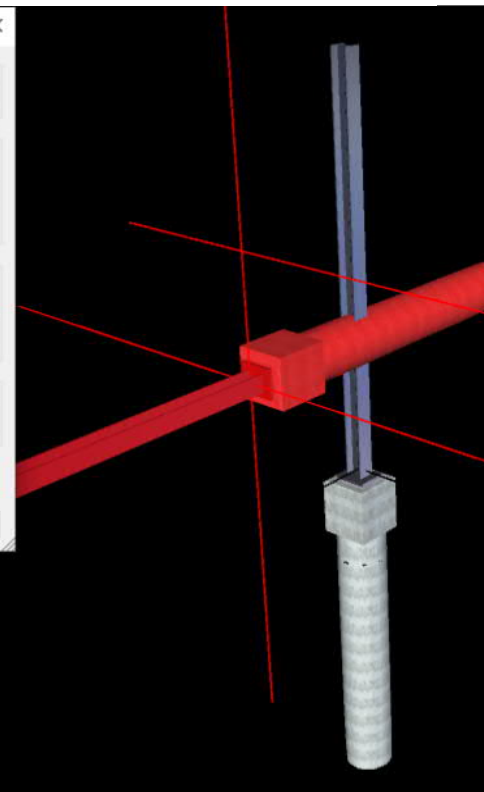
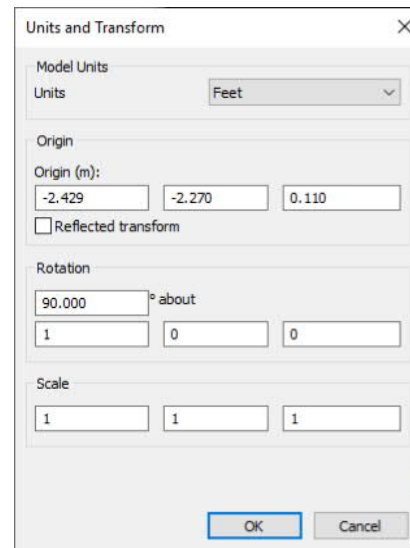
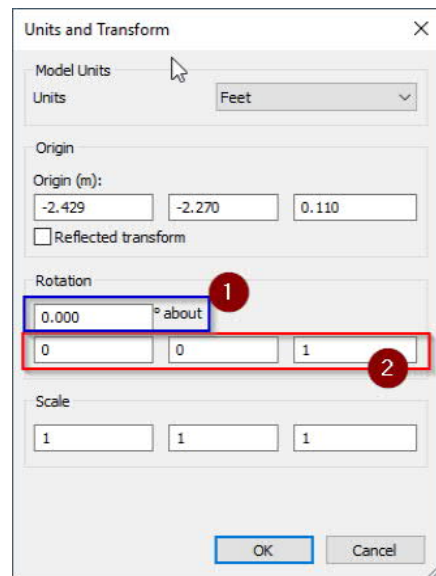
AutoCAD and Revit Axis

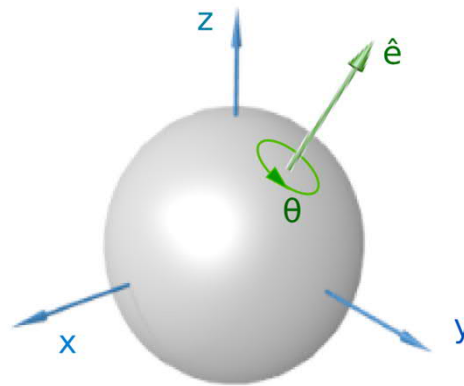


## Present model with custom data (cont.)



## 3D Rotation Question

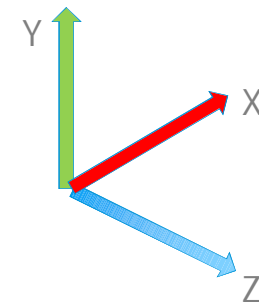
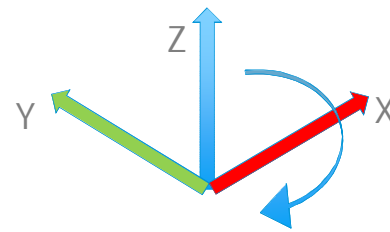
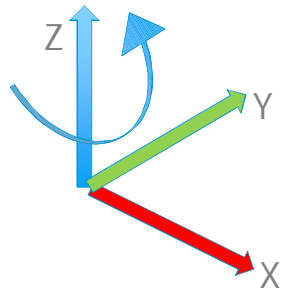
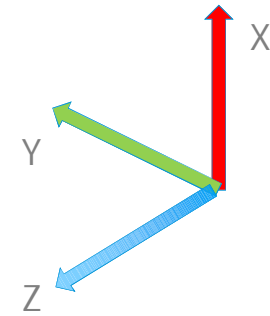
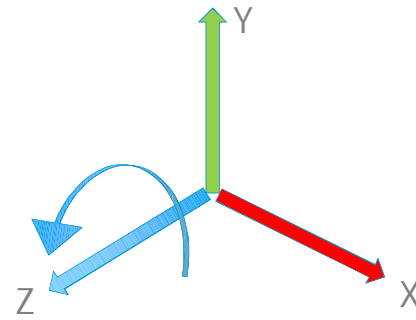
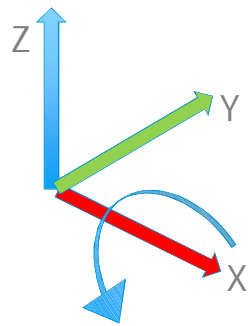




## Euler's rotation theorem

- In three-dimensional space, any displacement of a rigid body such that a point on the rigid body remains fixed, is equivalent to a single rotation about some axis that runs through the fixed point.
- It also means that the composition of two rotations is also a rotation.

## Rotation order matters



## Formula

$$R_x(\theta) = \begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos \theta & -\sin \theta \\ 0 & \sin \theta & \cos \theta \end{bmatrix}$$

Rotation matrix on X axis

$$R_y(\theta) = \begin{bmatrix} \cos \theta & 0 & \sin \theta \\ 0 & 1 & 0 \\ -\sin \theta & 0 & \cos \theta \end{bmatrix}$$

Rotation matrix on Y axis

$$R_z(\theta) = \begin{bmatrix} \cos \theta & -\sin \theta & 0 \\ \sin \theta & \cos \theta & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

Rotation matrix on Z axis

## Final Rotation Matrix

1. Rotate around X axis  $90^\circ$ ;
2. Rotate around Z axis  $82.163^\circ$

$$R_x(\theta) = \begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos \theta & -\sin \theta \\ 0 & \sin \theta & \cos \theta \end{bmatrix}$$

$$R_z(\theta) = \begin{bmatrix} \cos \theta & -\sin \theta & 0 \\ \sin \theta & \cos \theta & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

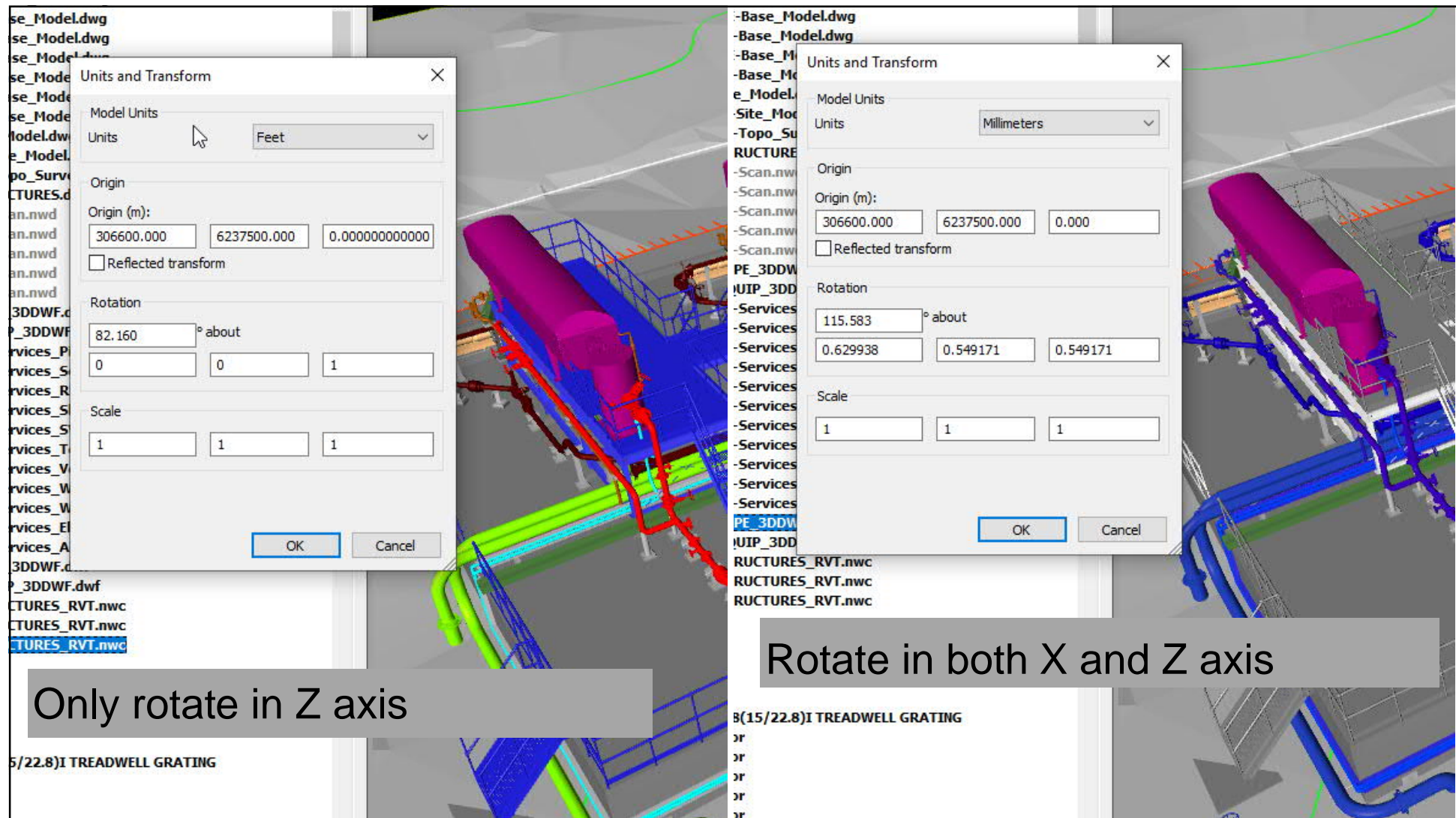
$$\begin{bmatrix} 1.0000 & 0.0000 & 0.0000 \\ 0.0000 & 0.0000 & -1.0000 \\ 0.0000 & 1.0000 & 0.0000 \end{bmatrix} \times \begin{bmatrix} 0.1364 & -0.9907 & 0.0000 \\ 0.9907 & 0.1364 & 0.0000 \\ 0.0000 & 0.0000 & 1.0000 \end{bmatrix} = \begin{bmatrix} m00 & m01 & m02 \\ m10 & m11 & m12 \\ m20 & m21 & m22 \end{bmatrix}$$

$$\text{angle} = \arccos((m00 + m11 + m22 - 1)/2) = 115.58^\circ$$

$$x = (m21 - m12) / \sqrt{(m21 - m12)^2 + (m02 - m20)^2 + (m10 - m01)^2} = 0.629938$$

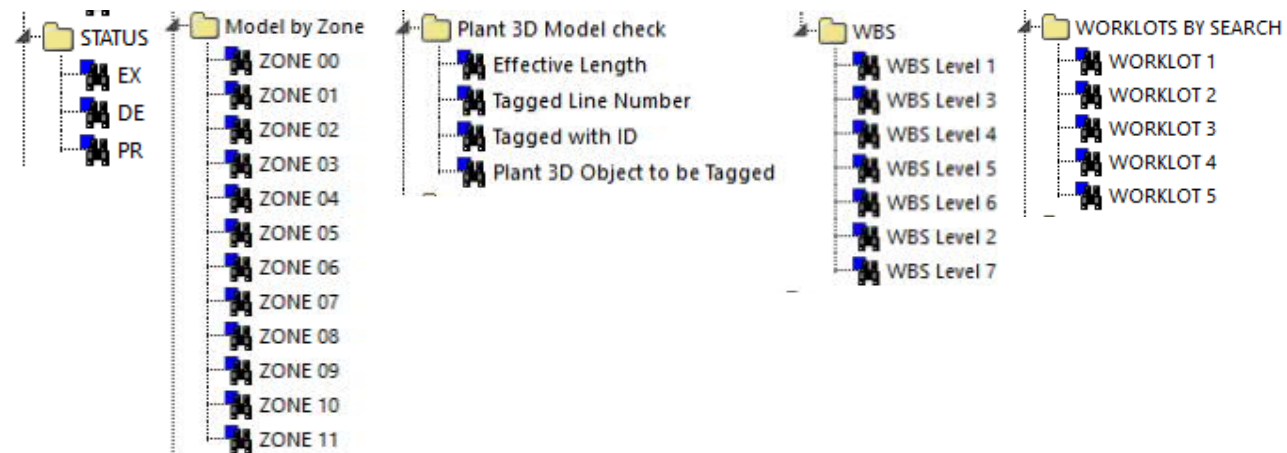
$$y = (m02 - m20) / \sqrt{(m21 - m12)^2 + (m02 - m20)^2 + (m10 - m01)^2} = -0.54917$$

$$z = (m10 - m01) / \sqrt{(m21 - m12)^2 + (m02 - m20)^2 + (m10 - m01)^2} = 0.549171$$

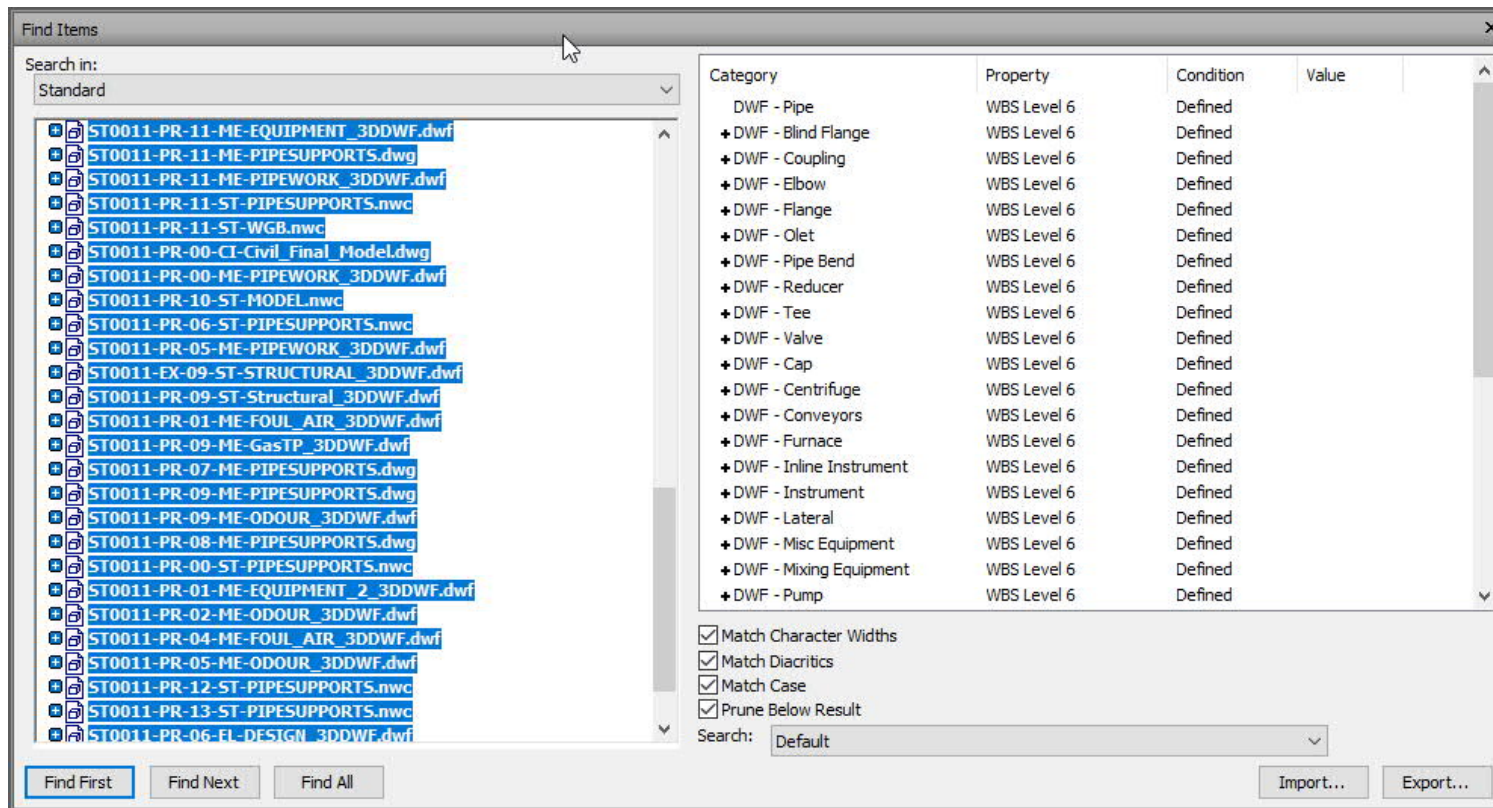




## Search with properties



## Search with properties



# Clash Detection

Clash Detective

01.New Structure vs. Existing Structure ⚠

Last Run: Saturday, 3 August 2019 3:57:16 PM  
Clashes - Total: 30 (Open: 13 Closed: 17)

Name	Status	Clashes	New	Active	Reviewed	Approved	Resolved
01.New Structure vs. Existing Structure	Old	30	0	0	13	1	16
02.New Structure vs. Existing Pipeworks	Old	0	0	0	0	0	0
03.New Structure vs. Existing Utilities (Electrical, Cabletray and other Services)	Old	0	0	0	0	0	0
04.New Structure vs. Existing Equipment	Old	0	0	0	0	0	0
05.New Pipeworks vs. Existing Structure	Old	37	0	0	0	10	27
06.New Pipeworks vs. Existing Pipeworks	Old	154	0	0	0	2	152
07.New Pipeworks vs. Existing Cabletray	Old	53	0	0	0	1	52
08.New Pipeworks vs. Existing Equipment	Old	2	0	0	0	0	2
09.New Cabletray vs. Existing Structure	Old	0	0	0	0	0	0
10.New Cabletray vs. Existing Pipeworks	Old	0	0	0	0	0	0
11.New Cabletray vs. Existing Cabletray	Old	0	0	0	0	0	0

Rules Select Results Report

Selection A

Sets

- PIPE-SERVICES
  - Model by Status
  - Model by Discipline
  - MODEL BY STAGE
  - Model Elements
    - Demolished
    - Existing - Current State
    - Proposed Design
      - Revit-Sheet Cladding
      - Incompiled Model Items
      - Drainage - New (C3D)
      - Structural - NEW
      - PIDTING - New (P3D)

Selection B

Sets

- PIPE-SERVICES
  - Model by Status
  - Model by Discipline
  - MODEL BY STAGE
  - Model Elements
    - Demolished
    - Existing - Current State
    - Proposed Design
      - Remaining
        - Services - Existing to be remained
        - Cabletray - Existing to be remained
        - Concrete Structure - Existing to be remained
        - Steel Structure - Existing to be remained

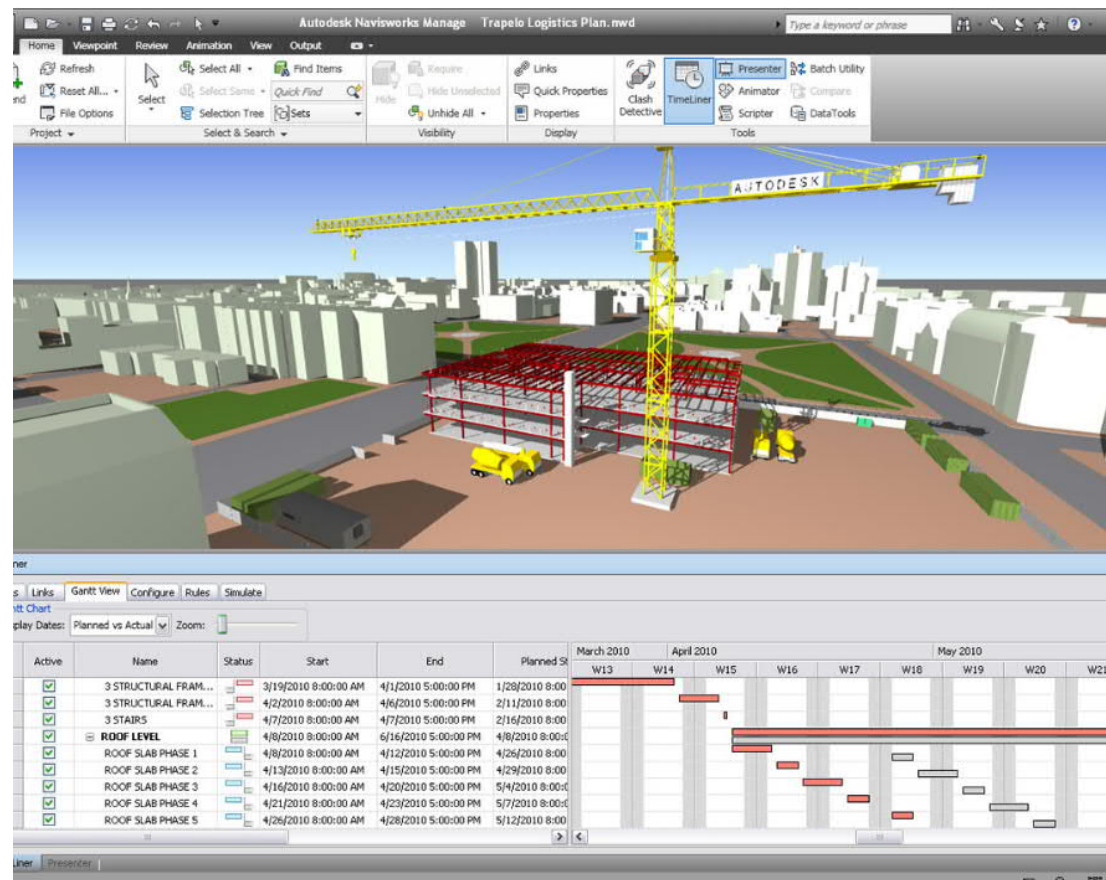
Settings

Type: Hard Tolerance: 0.001 m

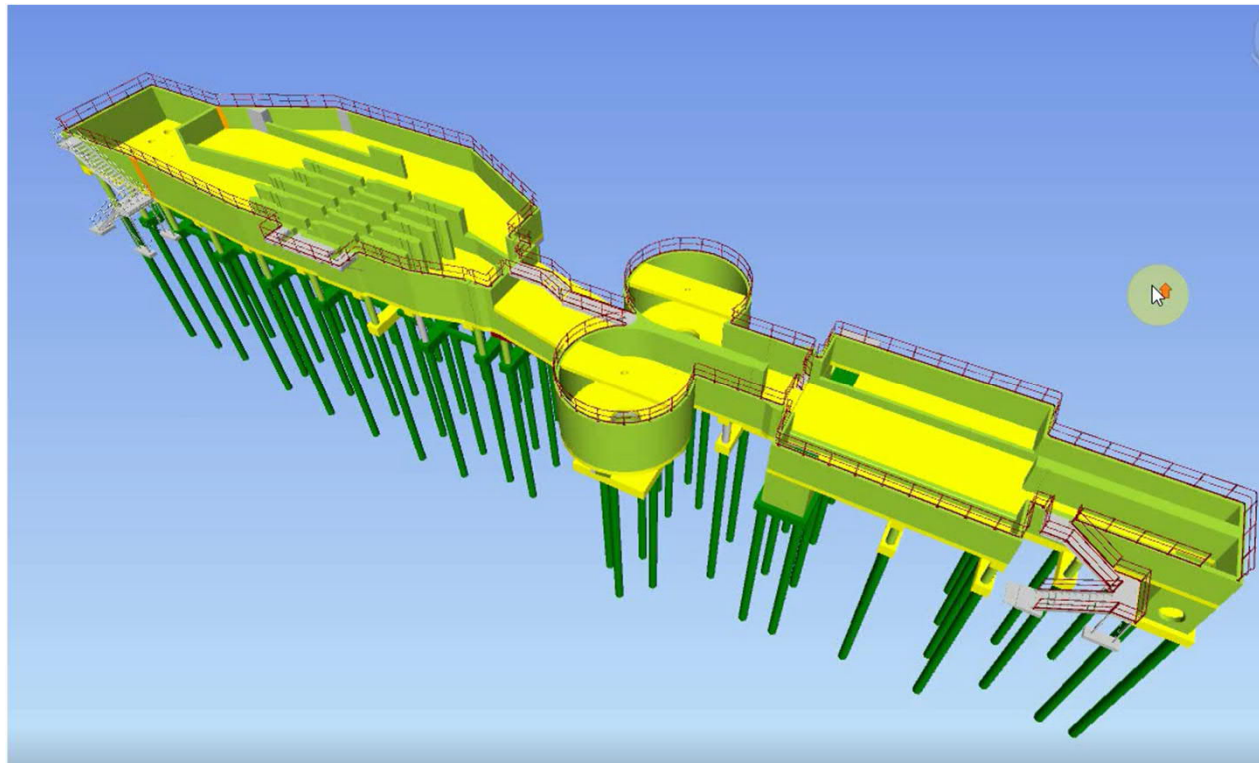
Link: None Step (sec): 0.1

☐ Composite Object Clashing

# Construction Simulation



## Other use of Data



## Model and Data quality

- Make sure spec is reviewed and approved before use
- Have rules about pipe group before start P&ID
- Make sure all pipe is connected and with correct pipe number
- Object tagging match with the project standard



Questions?





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