UT20934 – 3D Modeling Practices and Standards for Substations

Michael Chasser – Burns & McDonnell Substation Designer Section Manager
Jason Rugg – Burns & McDonnell Electrical Detailer
www.burnsmcd.com

Safety

Safety Topic – Hard Hat Safety

- ALWAYS wear a hard hat when in a work-zone
- Inspect hard hat daily for dings or defects, replace if found
- Ensure proper hard hat “class” is worn:
  - Class G – General Helmet
    - Impact resistance, electrical resistance up to 2,200V
  - Class E – Electrical Helmet
    - Electrical resistance up to 20,000V
  - Class C – Conductive Helmet
    - Per OSHA, these provide no protection against electrical hazards
    - Lightweight & more comfortable

HEAD PROTECTION CHART

Source	Assessment	Protection
Impact	Falling objects	Hard Hat. Specify type. (See ANSI performance requirements)
	Collision with fixed object	Hard Hat. (See ANSI performance requirements)
Electrical	Contact with exposed electrical wires, conductors	Class A or Class B Hard Hat, depending upon exposure. (See ANSI performance requirements)

American National Standards Institute (ANSI) Performance Requirements

	Class G	Class E	Class C
Description	General service, limited voltage protection	Utility service, high voltage protection	General service, metallic, no voltage protection
Material	Water resistant, slow burning	Water resistant, slow burning	Water resistant, slow burning
Insulation Resistance	2200V, 60Hz for 1 min. with 3 mA max. leakage	20,000V, 60Hz for 3 min. with 9 MA max. leakage	N/A
Flammability (Burn Rate)	3 in/min max	3 in/min. max	N/A
Impact Resistance (Transmitted Force)	850 lb average 1000 lb maximum	850 lb average 1000 lb maximum	850 lb average 1000 lb maximum
Penetration Resistance	3/8 in maximum	3/8 in maximum	7/16 in maximum
Standard	Z89.1-1969	Z89.2-1971	Z89.1-1969

Introductions

Michael Chasser

Burns & McDonnell Substation Design Section Manager

12 Years Substation Design Experience (12kV-765kV)

Inventor & Vault Experience – 2+ Years

Introductions

Jason Rugg

Burns & McDonnell Electrical Detailer

Autodesk Inventor Certified Professional

Inventor & Vault Experience – 12+ Years

Class summary

This class will cover:

- Industry best practices for 3D substation design utilizing Inventor & SBS Substation Design Suite.
- Vault integration to maximize efficiency.
- Processes that ensure consistency, flexibility, & usability of 3D models.

Key learning objectives

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

- Learn how to produce 3D models that are accurate, consistent, & user-friendly.
- Discover best practices for part and assembly creation.
- Learn how to use Vault to capitalize on 3D model data.
- Learn how to use Inventor to transform the substation design processes.

Learn how to produce 3D models that are accurate, consistent, & user-friendly

Begin at the End…

- What will the 3D models be used for?
- What data do we want from the 3D models?
- Who will be using the 3D models?

Make Decisions

- Visual Fidelity vs. Visual Identity
- What Models Should be Developed?
- Model Development Process

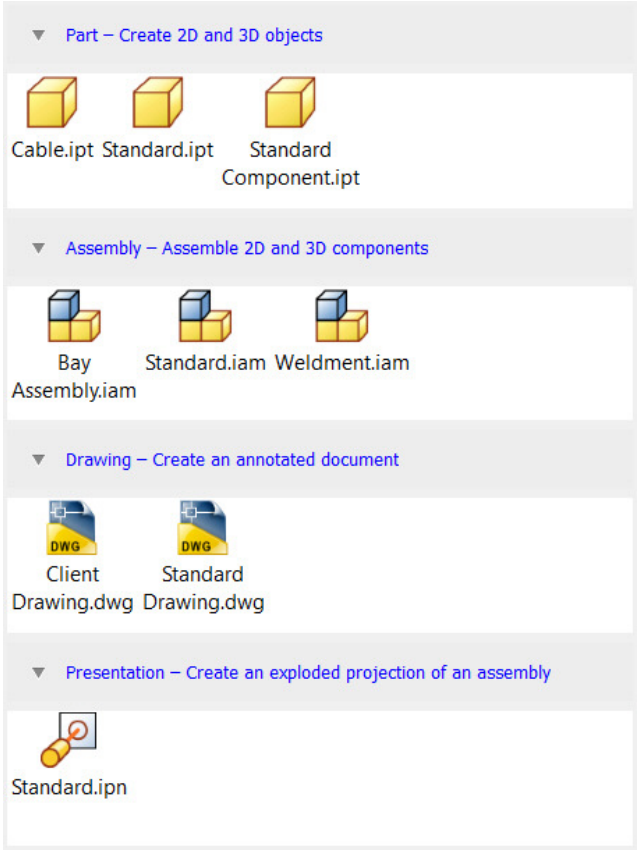
Make Decisions (cont'd)

- Determine Modeling Guidelines
- How will models/data be organized/tracked/controlled?
- File Naming Structure(s)

Discover best practices for part and assembly creation

Develop Templates

- Create Inventor project file (.ipj)
- Develop templates that are complete & well thought-out
  - .ipt (Part File)
  - .iam (Assembly File)
  - .idw &/or .dwg (Drawing File)
  - .ipn (Presentation File)
  - Changes to templates later create inconsistency
  - Possibly need multiple of each template type (depending on need) MAKE DECISIONS…



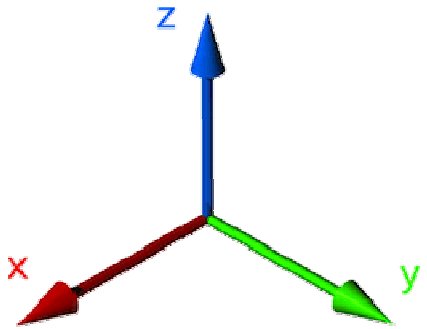
Best Practices

- Develop standard “library” of parts & assemblies (new & legacy)

Don’t reinvent the wheel

- Z-Axis should always be up

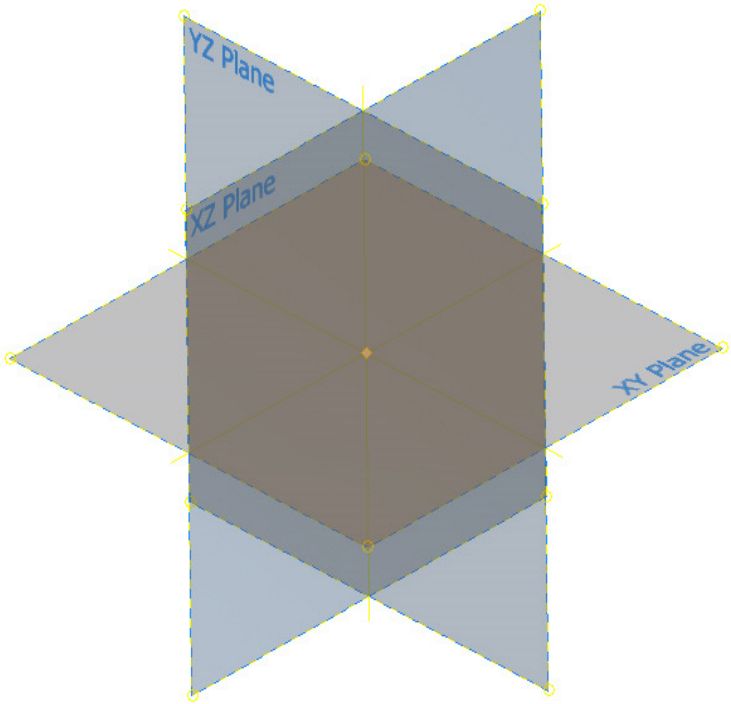
- Sketches should be fully constrained (when applicable)
  - When is it NOT applicable?



Best Practices (cont'd)

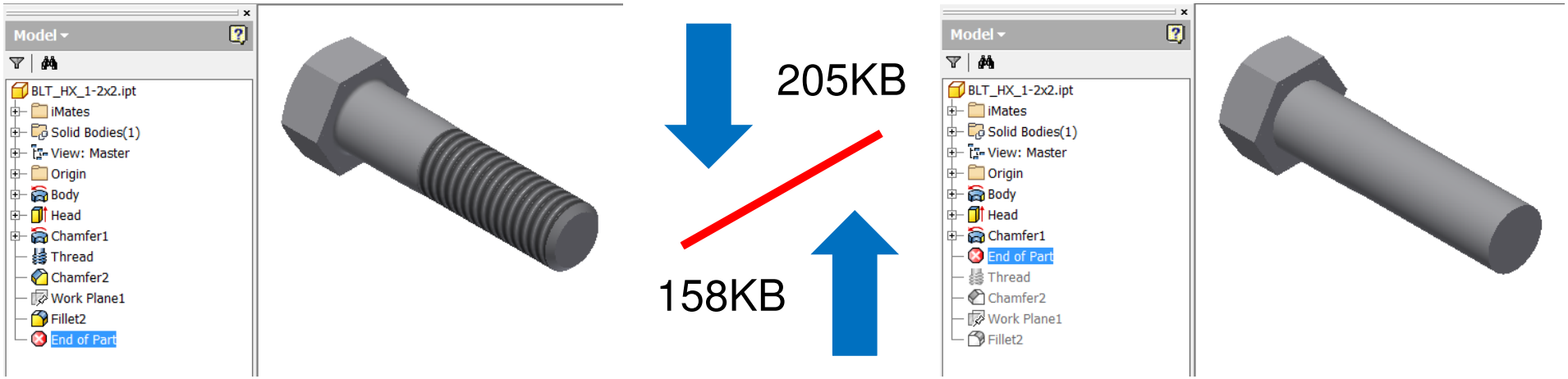
- Fill out iProperties while developing parts

- Use base origin point/planes/axis for constraints



Best Practices (cont'd)

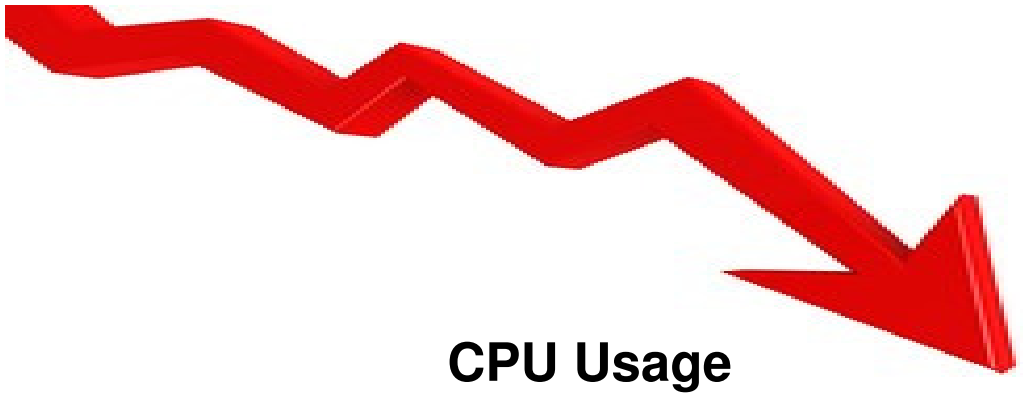
- Utilize End of Part Marker (EOP) to control feature visibility
  - Models are less resource intensive
  - Control visual fidelity
  - Decrease file size



Best Practices (cont'd)

- Minimize use of patterns and mirrors (grounded vs. not grounded)

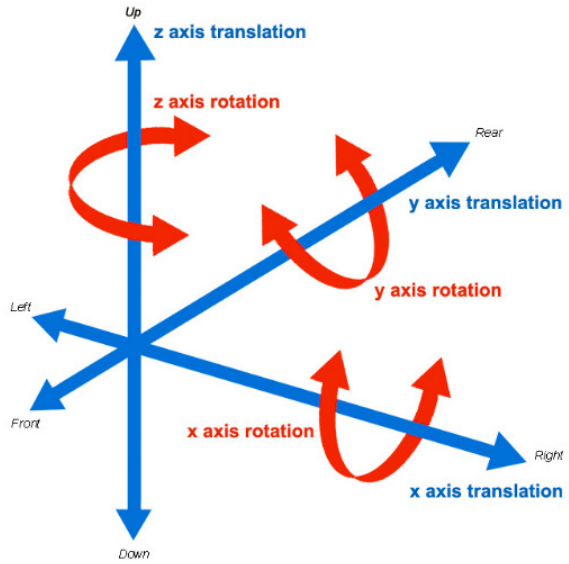
Using Patterns & Mirrors	Using Multiple Instances with Constraints	Using Multiple Instances & Grounding
15-30%	10-20%	5-15%

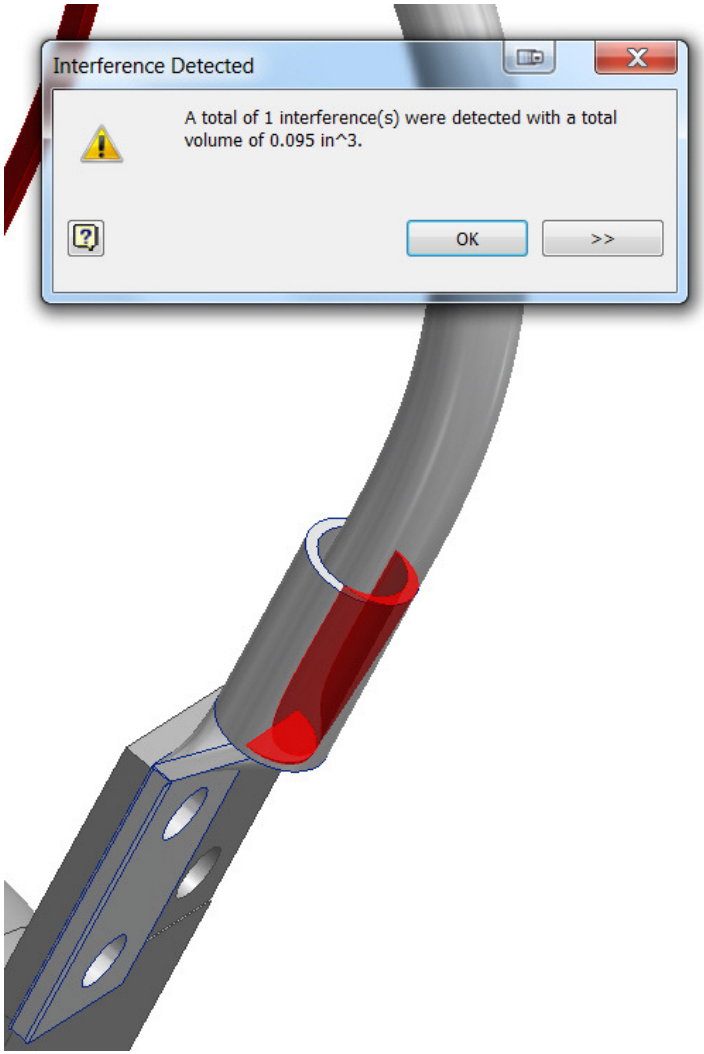


CPU Usage

Best Practices (cont'd)

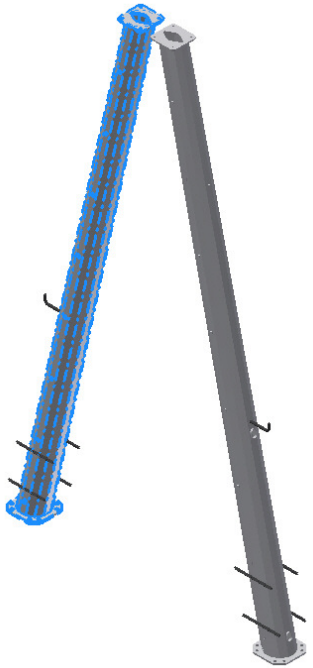
- Verify degrees of freedom
  - Assemblies only
- Use "analyze interference" tool





Best Practices (cont'd)

- Modular design approach
  - Develop parts, place into commonly used component assemblies
  - Place component assemblies into sub-assemblies
  - Place sub-assemblies into master assembly

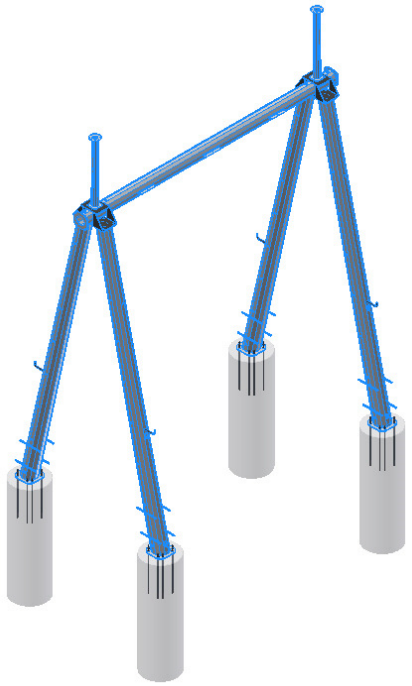


Best Practices (cont'd)

- Component Assembly Example

Best Practices (cont'd)

- Component Assembly Example

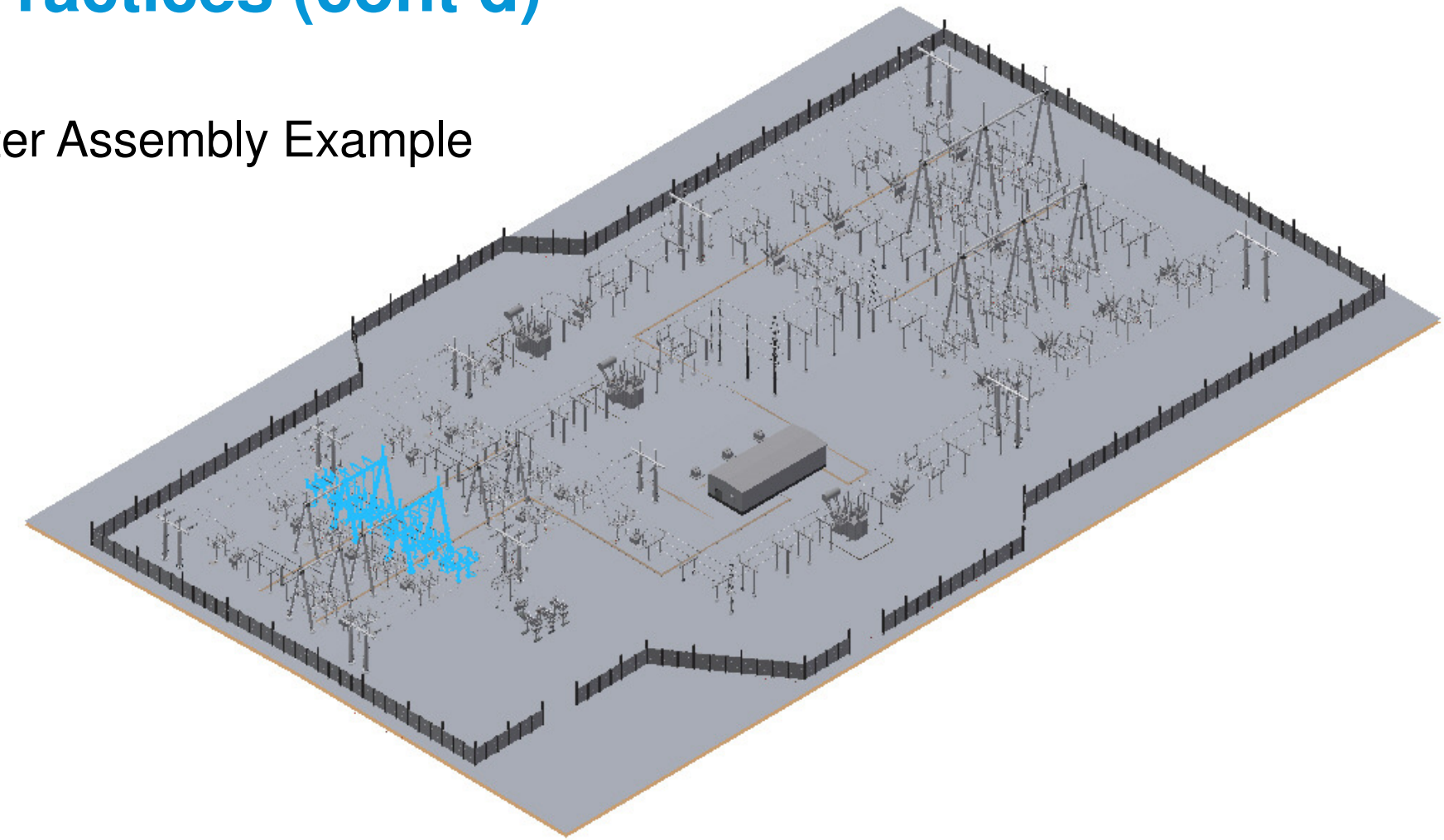


Best Practices (cont'd)

- Sub-Assembly Example

Best Practices (cont'd)

- Master Assembly Example



Best Practices (cont'd)

- Utilize Level of Detail (LOD)
- Keep browser tree organized
- Use "enforce unique file names" feature within Vault

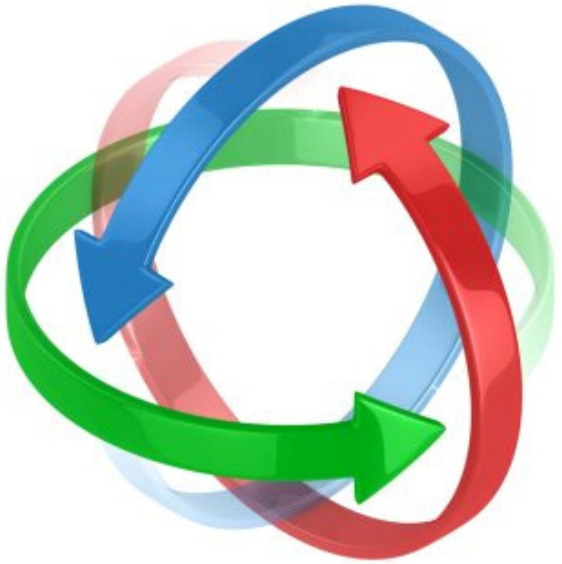
Learn how to use Vault to capitalize on 3D model data

Vault Setup

- User-groups/permissions
  - Folder structure

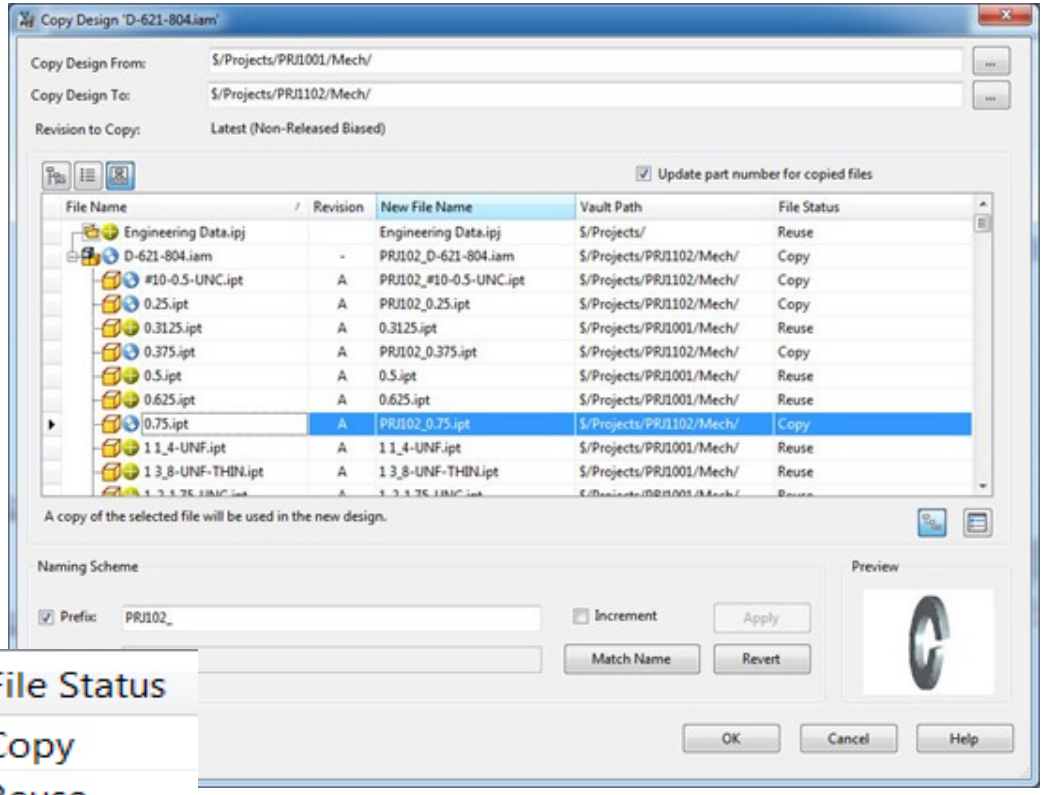
Vault Setup

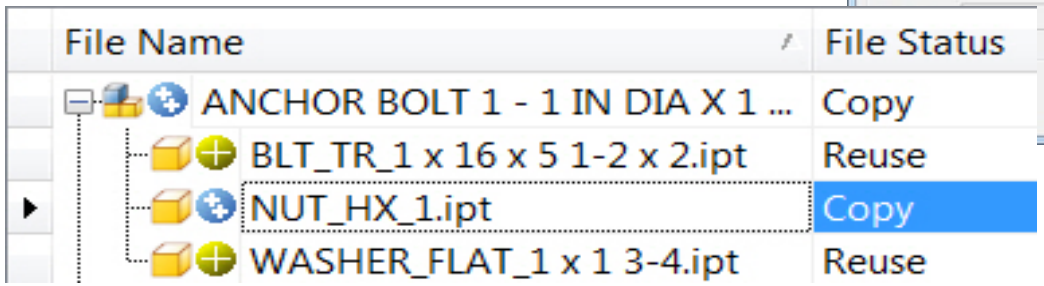
- Lifecycles
  - Use to enforce adherence to policies & procedures
  - Utilize Vault states to progress through processes
- Categories
  - Use to organize files & enforce adherence to policies & procedures (differing entities within one company)



Copy Design

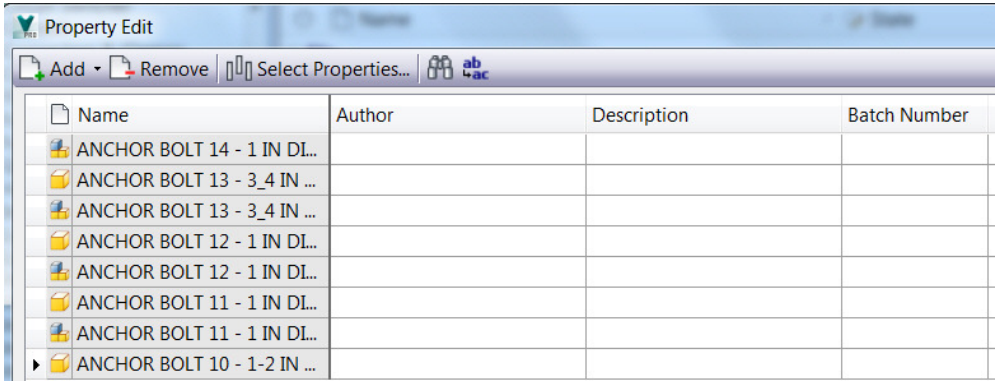
- Re-used vs. Copied
- Prefix/Suffix Naming Scheme (if applicable)

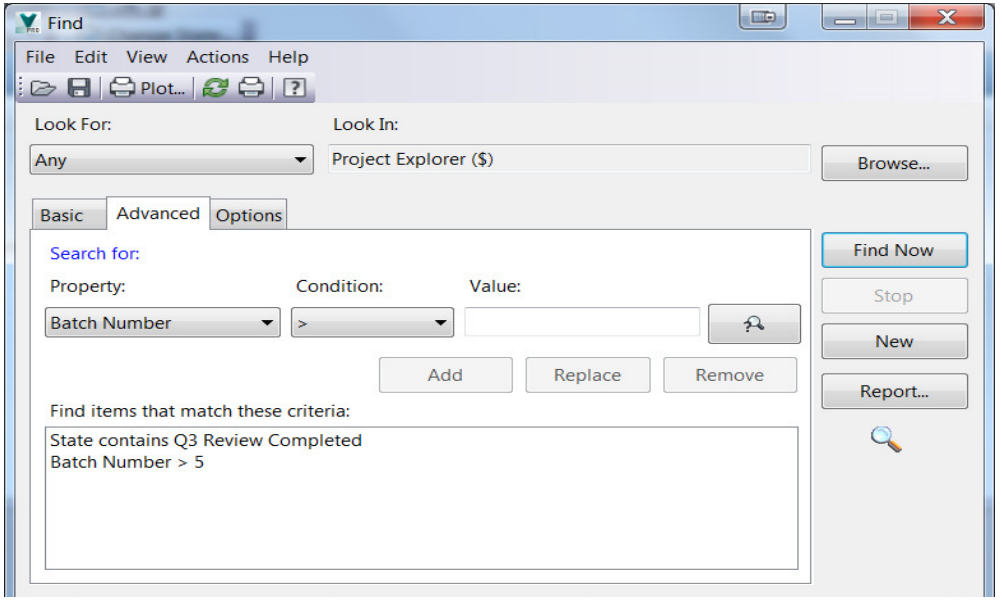


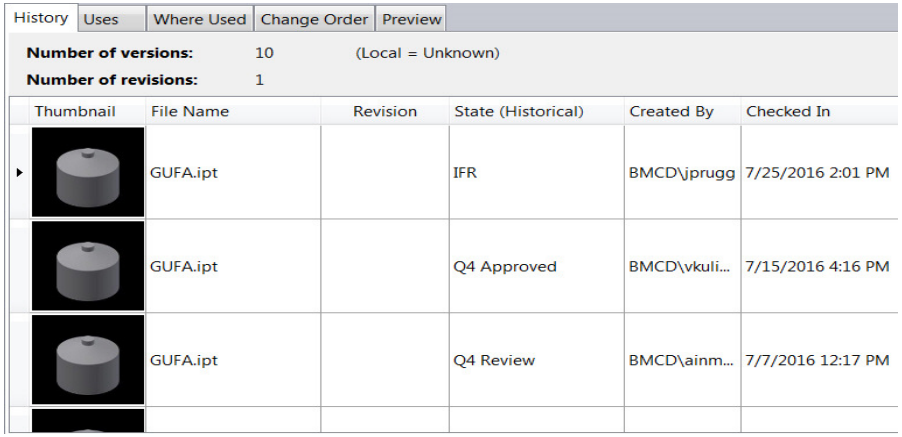


Managing Information

- Mass iProperty Editing
- Advanced Search Capabilties
- File tracking & linking

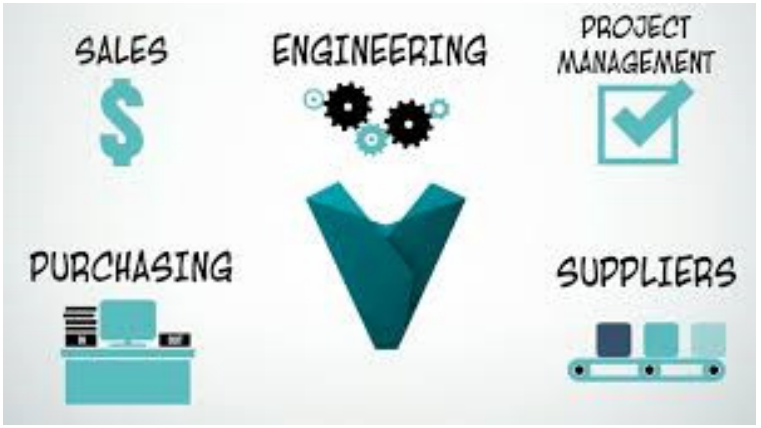






Vault Reporting

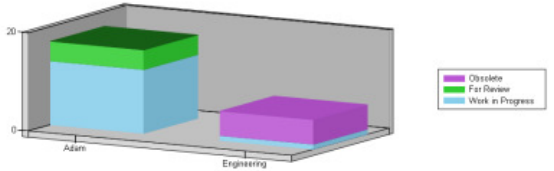
- Create customizable reports for reporting on various aspects of a project:



Autodesk®

System File Properties by Category Report

Generated By:
Date: 12/9/2009 12:27:06 PM
Search Root:
Search Conditions:



Autodesk

Transmittal Report

Generated By: Administrator
Date: 9/8/2010 21:38:15
Source: $/Designs/Layout/
Action: Pack and Go
Destination: C:\Users\schanenb\Desktop\E-621-000.zip

Transmitted Files:

Name	Revision	State	Vault Folder	Date Version Created
E-621-000.dwg	B	Released	$/Designs/Layout/E-621-000.dwg	9/1/2010 15:10:35
E-621-000-1.ipn	B	Released	$/Designs/Layout/E-621-000-1.ipn	9/1/2010 15:10:35
E-621-000.iam	B	Released	$/Designs/Layout/E-621-000.iam	9/1/2010 15:10:35
1208-B-20-0005.iam	A	Released	$/Designs/Engineering/Drive/1208-B-20-0005.iam	3/18/2010 23:17:42
Synchronous Belts Transmission2.iam	B	Released	$/Designs/Engineering/E-621-000/Design Accelerator/Synchronous Belts Transmission2.iam	9/1/2010 15:10:36
Parallel Spline Connection2.iam	B	Released	$/Designs/Engineering/E-621-000/Design Accelerator/Parallel Spline Connection2.iam	9/1/2010 15:10:36
Shaft2.iam	B	Released	$/Designs/Engineering/E-621-000/Design Accelerator/Shaft2.iam	9/1/2010 15:10:35
E-621-100-SM.ipt	A	Released	$/Designs/Engineering/E-621-100-SM.ipt	3/18/2010 23:17:42
090620-901.ipt	A	Released	$/Designs/Engineering/Drive/0906	3/18/2010 23:17:42

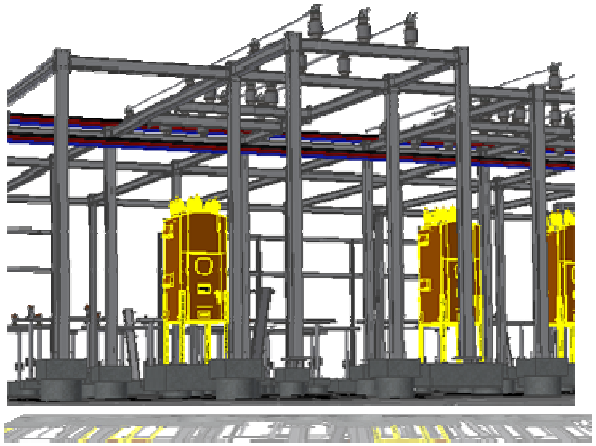
Adam

File Name	Extension	Revision	State	Check In Date	Checked In By	Comment
Catch Body.ipt	IPT	A	For Review	12/9/2009	Administrator	Under review
Catch Spring - Coil.ipt	IPT	A	For Review	12/9/2009	Administrator	Under review
Catch Spring - Flat.ipt	IPT	A	For Review	12/9/2009	Administrator	Under review
Catch Assembly.iam	IAM	A	For Review	12/9/2009	luttens	

Learn how to use Inventor to transform the substation design processes

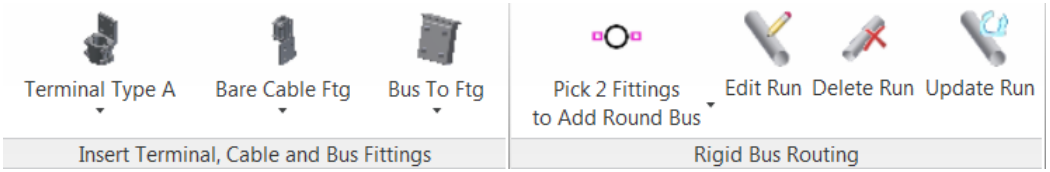
Autodesk Inventor/SBS Substation Design Suite

sbs
Substation Design Suite™

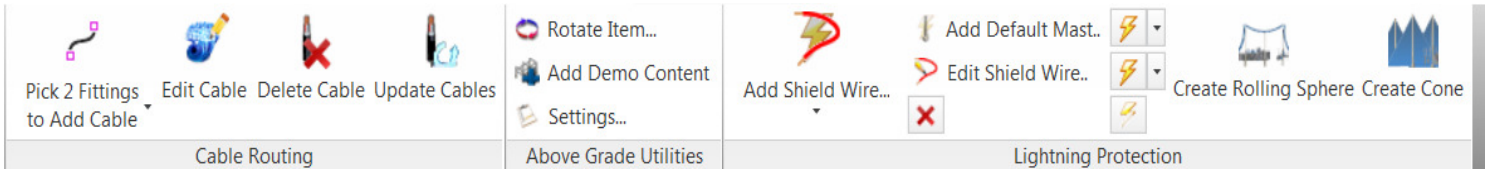


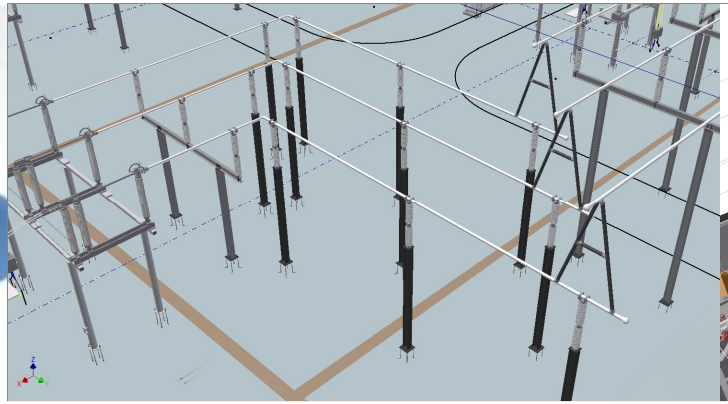
- Powerful Configuration Capabilities
- SBS Substation Design comes standard with several tools that allow you to configure hardware selections like fittings and clamps to your own standards.
- Build out several standard configurations for various regions or engineering firms can create separate configurations for each customer.
- With the built in ability to add your own hardware and configure things like clearance values, iProperties and fitting classes.

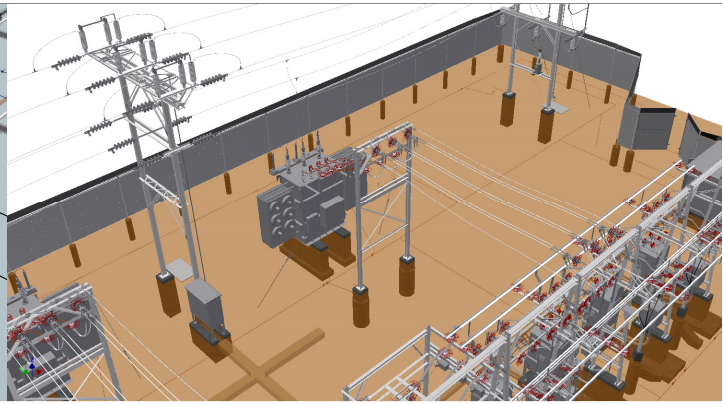
Above Grade Tools



- Insert Terminal, Cable & Bus Fittings
- Rigid Bus Routing
- Cable Routing
- Lightning Protection

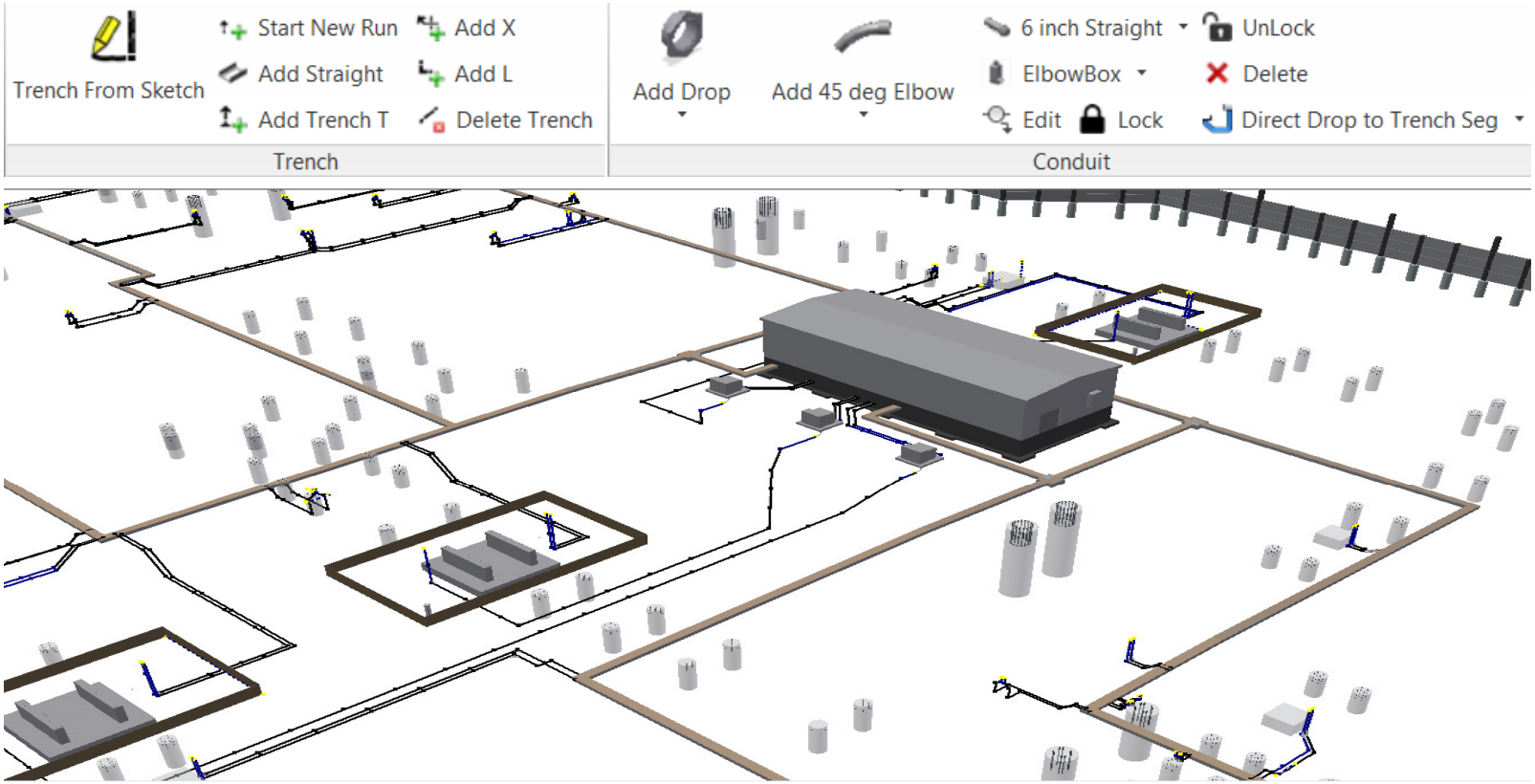






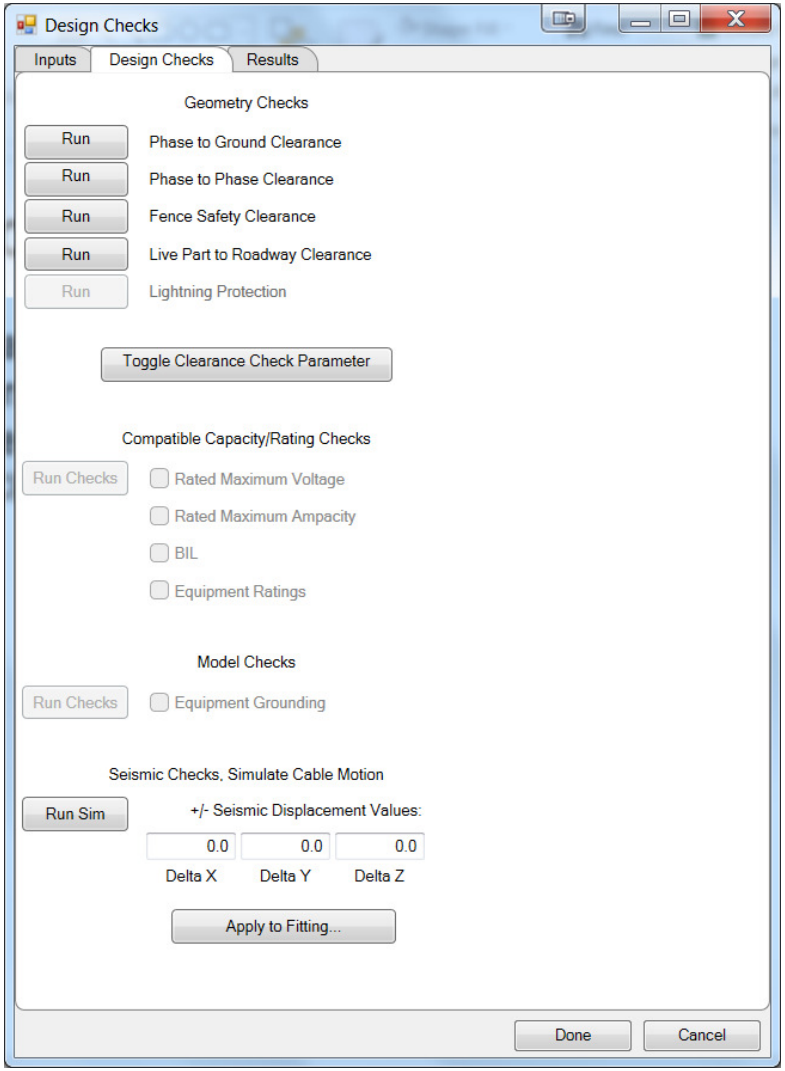
Below Grade Tools

- Grounding
- Trench
- Conduit



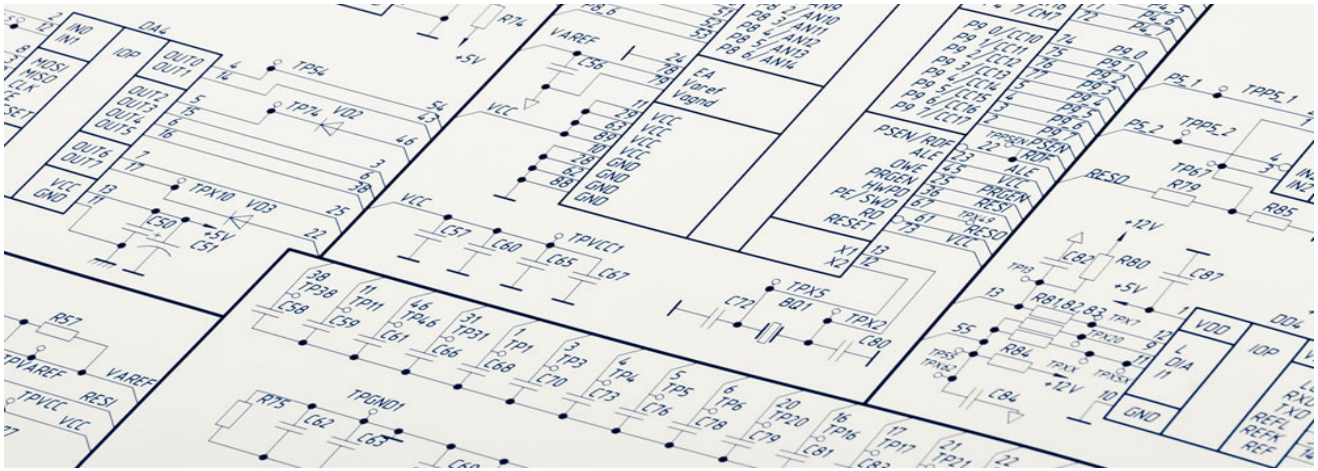
Design Check Tools

- Phase to Ground Clearance
- Phase to Phase Clearance
- Fence Safety Clearance
- Live Part to Roadway Clearance



AutoCAD Electrical Integration

- Inventor/AutoCAD Electrical Versions 2016 or Greater
- Establishes Electromechanical Link (.emx) between Inventor and AutoCAD Electrical to facilitate interdisciplinary checking
- Schematic diagrams can be checked within Inventor and vice versa



Questions?