AUTODESK UNIVERSITY 2013

Autocad® Utility Design 2014 Work Flow and Systems Integration at Colorado Springs Utilities (CSU)

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UT2332

Colorado Springs Utilities (CSU) discusses implementation strategies of Autocad® Utility Design (AUD) 2014 from design to asset realization. CSU discusses AUD standardization, uniform process and data flow, and their incorporation into upstream and downstream workflow to produce reliable engineering designs.

Learning Objectives

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

- Identify standards needed to support and implement AUD Electric Design.
- Walk through an existing work flow of a utility implementing AUD 2014 Electric. AUD gas will be implemented next year.
- Design a conceptual model to support Computerized CMMS, field inventory, GIS and billing systems.
- Construct and utilize engineering information through downstream and upstream system integration.

Examples are based on CSU streetlights and pole heads due to their complexity.

About the Speaker

Thomas Whitehouse is presently an IT Project Manager at Colorado Springs Utilities and has supported, developed and managed the electric and gas system extension systems, GIS products, field inventory system and integration with GIS, Computerized Maintenance Management System(CMMS), billing and financial systems. He holds a Master's degree in GIS from the University at Buffalo and a Master's degree in Geography with Engineering from Kansas State University. Most of his 18 year career has focused on utilities mapping and engineering systems and integration with enterprise systems in the public and private utilities.

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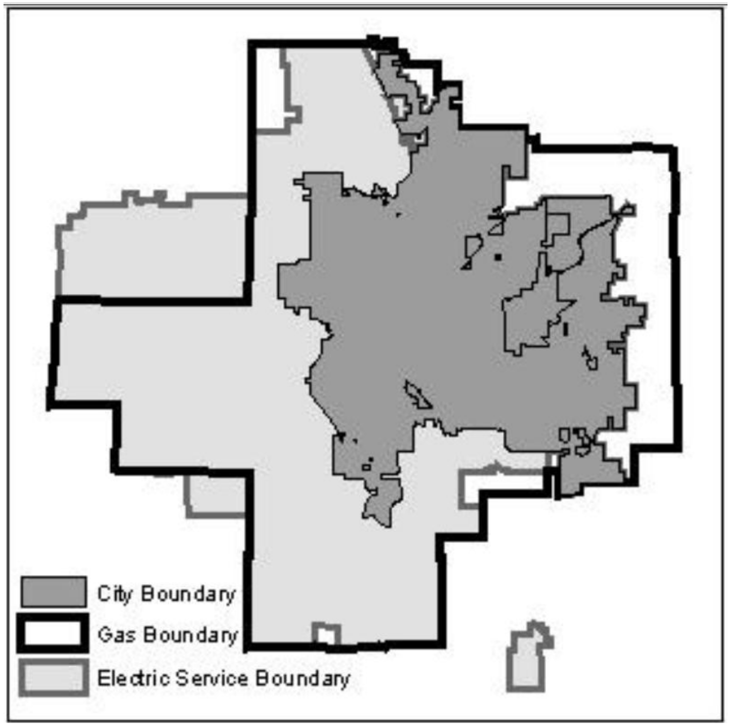
Colorado Springs Utilities Background

- Colorado Springs Utilities is a 4-service municipal utilities company located at the foot of Pikes Peak in Colorado between Pueblo and Denver. Its 1800 employees supply natural gas, electricity, water, and wastewater services to a community of approximately 350,000 customers/owners.



Service Agreements include:

Electric	213,433
Gas	189,498
Sewer	132,470
Water	136,231
Non Service*	171,968

i.e. Carbon Monoxide sales, temporary contract assistance, etc.

The CSU electric system provides retail service to metropolitan Colorado Springs and Manitou Springs and delivers special contract power to the Air Force Academy (USAFA), Peterson Air Force Base, Fort Carson, and Cheyenne Mountain Air Station. Colorado Springs Utilities has an electric franchise to serve Manitou Springs through 2025. Colorado Springs Utilities' electric service area is approximately 470 square miles serving 212,966 electric meter accounts as of Dec, 2011 which has been our largest operating year to date. Annual budget of 1.154 billion dollars in 2014.

Learning Objective 1 - Identify standards needed to support and implement AUD Electric Design.

Standards Dilemma When No Standards Exist

If the electric utility organization does not have standards, strongly consider using an exist standard template such as RUS, an AUD out of the box standard adhering to the Rural Utility Service of USDA, perhaps consider adding attributes as needed, i.e. identifier. The template will contain a base line of models, rules, structures and models to get an organization started.

Most Organizations Have Standards in Some Form

- An Approach is Needed to Identify Standards to Work with AUD.
- Identify and use a mechanism to systematically achieve standardization and improved workflow (discussed in sections 2-4).
- Find differences in the template, start with base style/symbol and model and slightly change as needed (attributes, style, ports).

Compare the Electric Feature Standards (Your standards vs AUD standard)

As an example that has the most complexity: a 3d overhead model with ports, levels and various attributes, let's examine one of the most complicated engineering components-pole heads / cross arms.

We compare CSU CU's to RUS Model (an AUD out of the box standard template) through populating the the AUD Industry Model with 3D Configuration.

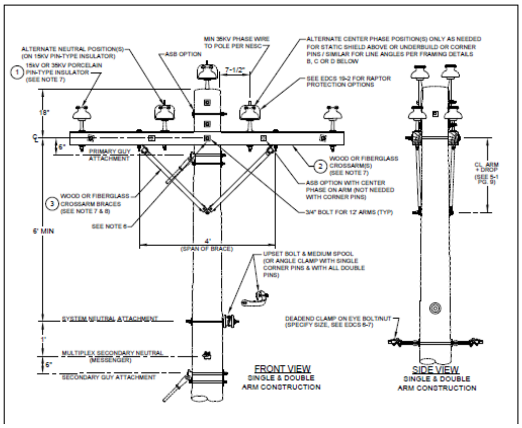
In our example we use Pole Head Configuration – To Capture 3D Modeling
Main feature points that were observed

- Primary Voltage
- Connected phase – Three Phase vs. Single Phase
- Arm Length
- Pin (insulator) configuration
- Neutral Location

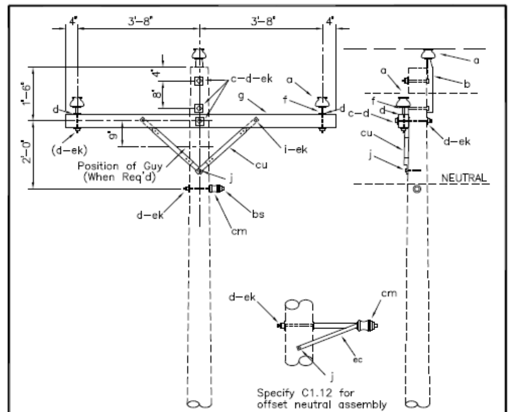
Once a suitable RUS design was determined the 3D model was then associated to Colorado Springs CU's.

The construction detail and Colorado Model and AUD standard model name in our example:

Colorado Springs CU	Description	RUS Associated Construction Specification
E.AR-15KV-3PH-SGL-8	3-Phase Crossarm Framing, 15 kV, single 8'	C1.11



CSU Construction Standard



ITEM	MATERIAL	ASSEMBLY: C1. 11 QTY	12 QTY
a	Insulator, pin type, (12.47/7.2 kV)	3	3
b	Pin, pole top, 20"	1	1
c	Bolt, machine, 5/8 x req'd length	3	3
d	Washer, square, 2 1/4"	7	7
f	Pin, crossarm, steel, 5/8" x 10 3/4"	2	2
g	Crossarm, 3 5/8" x 4 5/8" x 8'-0"	1	1
i	Bolt, carriage, 3/8" x 4"	2	2
j	Screw, lag, 1/2" x 4"	1	3
bs	Bolt, single, upset	1	
cm	Insulator, spool, 3"	1	1
cu	Brace, 28"	2	2
ec	Bracket, offset neutral		1
ek	Locknuts	6	6

DESIGN PARAMETERS:
MAXIMUM LINE ANGLES:
5° – Small Conductors
2° – Larger than #1/0

SINGLE SUPPORT ON CROSSARM (TANGENT)

APRIL 2005 | RUS | 3 – PHASE PRIMARY 12.47/7.2 kV | C1.11 (C1) C1.12 (C1A)

Steps to Perform Comparisons to AUD Standard Template

- When RUS standards were not available created new 3D models from scratch (example: alley arms)

- We have converted our standards to the standard industry Model in AUD. We have found almost all attributes fit into the model(most are industry standard) and very few new attributes need to be added. These have occurred when we can't access a way to query attributes through the AUD Rules.

- Use most likely match, limit variables needed to update including:

  Symbols; One to One Match; Engineering Calculations

- If one of these areas does not exist base it on patterns of present industry model like RUS standard template as the standard template will have basics of what you need

- It will also have higher confidence of compatibility with rules and engineering calculations with AUD out of the box

CSU Standards Background as an Example

CSU has approximately 1900 CUS for electric; 1100 for gas with more than 50% of electric equipment has some form of customization. *How standards of Models/CUs is represented, with minimal changes of AUD out of the box is key*. When mapping your electric features to the standard, even if nomenclature is different keeping "Categories" grouping(i.e. Model Group) and using models similar to standard template. Strongly consider keeping base attributes of components that exist in the AUD out of the box template and adding your own. This helps with applying rules through filtering and sorting.

Examples of What Can be Leveraged Out of the Box with Slight Adjustments.

Our slight adjustments initially included:

- Pole Heads = Cross Arm Framing, but we kept the pole head category.
- Kept Jboxes, but used as a Handhole structure.
- LBU = Load Break Unit is used as a Fuse Feature Class.

It may be necessary to sort out some of the names through filter and sorting.

Functionality We Gained Out of the Box

With Transformer sizing a transformer can be chosen that will service specific load, but not under size or overbuild with an unnecessarily more expensive transformer.

- Can select appropriate poleheads/cross arms for conductor.
- Can select appropriate pole size for conductor selected.
- Can tie specific equipment to appropriate level.

We tried to stay with feature classes and structures out of the box to utilize AUD's model and original configuration and rules best.

Used Structures Where Possible

Used structures where ever possible, but some cases where not used. Helps with organizing the design information, utilizes AUD built-in relationships. Can generate identifiers and assign whether a device or structure, but prefer to place on a structure. Need to keep in mind how this is organized when setting up Workflow and upstream and downstream processes. We ran into questions on transformers whether to use transformers directly and include pad.

Model/CU Comparison: Our Approach

Least Common Denominator approach is taken. Find out what is needed and make sure it has all necessary storage for attributes and compare models. The following table matched some of our compatible units to CSU Models/CUs.

Example of Alley Arms not having Compatible AUD RUS Standard CU

Here we have a 3d Model from AUD out of the box and a corresponding CU. We match the attributes and migrate them over to the new AUD standard. Where attributes do not exist we add them and populate them.

AUD 3D Model Name	CSU CUID	DESCRIPTION	RUS COMPATABLE CU
10' Double Alley Arm 3D(3)	E.ALLEY-15KV-3PH-DBL-10	3-Phase Alleyarm Framing (Tangent & Small Angle Structures), 15 kV insulators, double 10 foot wood arms & double insulators.	
10' Double Alley Arm 3D(3)	E.ALLEY-15KV-3PH-DBL10FG	3-Phase Alleyarm Framing (Tangent & Small Angle Structures), 15 kV insulators, double 10 foot fiberglass arms & double insulators.	
8' Double Alley Arm 3D(2)	E.ALLEY-15KV-3PH-DBL-8	3-Phase Alleyarm Framing (Tangent & Small Angle Structures), 15 kV insulators, double 8 foot wood arms & double insulators.	
8' Double Alley Arm 3D(2)	E.ALLEY-15KV-3PH-DBL8FG	3-Phase Alleyarm Framing (Tangent & Small Angle Structures), 15 kV insulators, double 8 foot fiberglass arms & double insulators.	
Fiberglass Alley Arm wo Brace(2)	E.ALLEY-15KV-3PH-FG-6	3-Phase Alleyarm (Tangent & Small Angle Structures), 15 kV pin insulators, fiberglass (6ft) arm.	
Fiberglass Alley Arm wo Brace(2)	E.ALLEY-15KV-3PH-FG-6&BR	3-Phase Alleyarm (Tangent & Small Angle Structures), 15 kV pin insulators, fiberglass (6ft) arm with fiberglass brace.	
10' Single Alley Arm 3D(2)	E.ALLEY-15KV-3PH-SGL-10	3-Phase Alleyarm Framing (Tangent & Small Angle Structures), 15 kV insulators, single 10 foot wood arm.	
10' Single Alley Arm 3D(2)	E.ALLEY-15KV-3PH-SGL10FG	3-Phase Alleyarm Framing (Tangent & Small Angle Structures), 15 kV insulators, single 10 foot fiberglass arm.	
8' Single Alley Arm 3D(2)	E.ALLEY-15KV-3PH-SGL-8	3-Phase Alleyarm Framing (Tangent & Small Angle Structures), 15 kV insulators, single 8 foot wood arm.	
8' Single Alley Arm 3D(2)	E.ALLEY-15KV-3PH-SGL8FG	3-Phase Alleyarm Framing (Tangent & Small Angle Structures), 15 kV insulators, single 8 foot FG arm.	

Sample of No AUD 3d Model to match CSU CU

AUD 3D Model Name	CSU CUID	DESCRIPTION	RUS COMPATABLE CU
	E.ALLEY-35KV-3PH-DBL-10	3-Phase Alleyarm Framing (Tangent & Small Angle Structures), 35 kV insulators, double 10 foot wood arms & double insulators.	
	E.ALLEY-35KV-3PH-DBL10FG	3-Phase Alleyarm Framing (Tangent & Small Angle Structures), 35 kV insulators, double 10 foot fiberglass arms & double insulators.	
	E.ALLEY-35KV-3PH-DBL-8	3-Phase Alleyarm Framing (Tangent & Small Angle Structures), 35 kV insulators, double 8 foot wood arms & double insulators.	
	E.ALLEY-35KV-3PH-DBL8FG	3-Phase Alleyarm Framing (Tangent & Small Angle Structures), 35 kV insulators, double 8 foot fiberglass arms & double insulators.	
	E.ALLEY-35KV-3PH-SGL-10	3-Phase Alleyarm Framing (Tangent & Small Angle Structures), 35 kV insulators, single 10 foot wood arm.	
	E.ALLEY-35KV-3PH-SGL10FG	3-Phase Alleyarm Framing (Tangent & Small Angle Structures), 35 kV insulators, single 10 foot fiberglass arm.	
	E.ALLEY-35KV-3PH-SGL-8	3-Phase Alleyarm Framing (Tangent & Small Angle Structures), 35 kV insulators, single 8 foot wood arm.	
	E.ALLEY-35KV-3PH-SGL8FG	3-Phase Alleyarm Framing (Tangent & Small Angle Structures), 35 kV insulators, single 8 foot fiberglass arm.	

Sample of AUD standard Model that matches CSU Standard Models/CUs, but still no 3d Model.

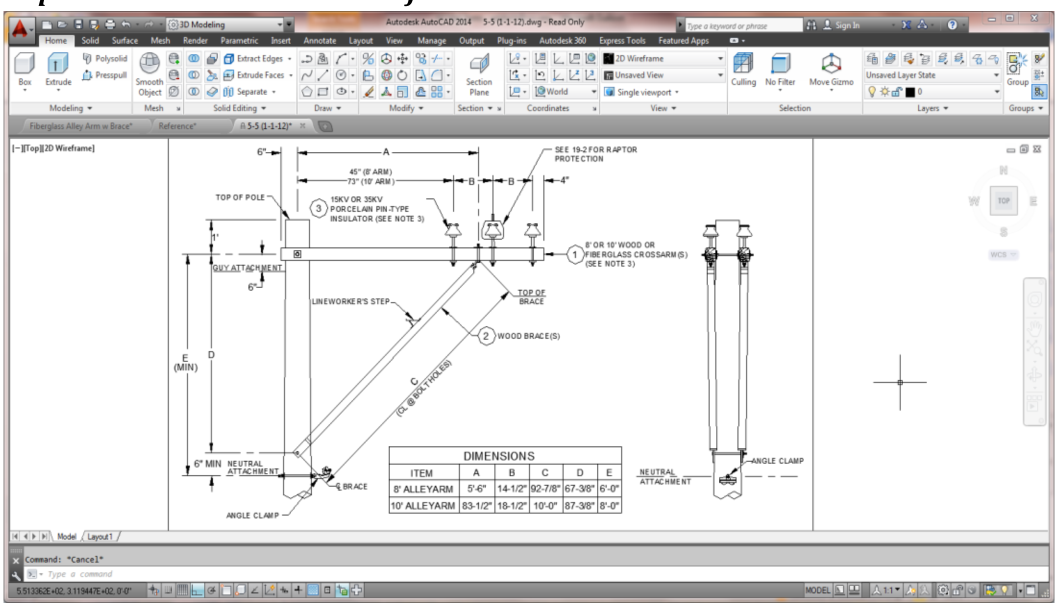
AUD 3D Model Name	CSU CUID	DESCRIPTION	RUS COMPATABLE CU
	E.AR-15KV-1PH-DBL-8	1-Phase Crossarm Framing, 15kV, double 8' arms	A2.21
	E.AR-15KV-1PH-DBL8FG	1-Phase Crossarm Framing, 15kV, double 8' fiberglass arms	A2.21
	E.AR-15KV-1PH-DDE-DBL-10	1-Phase Crossarm Framing, 15kV insulators, double deadend on double 10 foot arms.	A6.21
	E.AR-15KV-1PH-DDE-DBL10FG	1-Phase Crossarm Framing, 15kV insulators, double deadend on double 10 foot fiberglass arms.	A6.21

AUD Requirements and Technical References for Pole Head Example

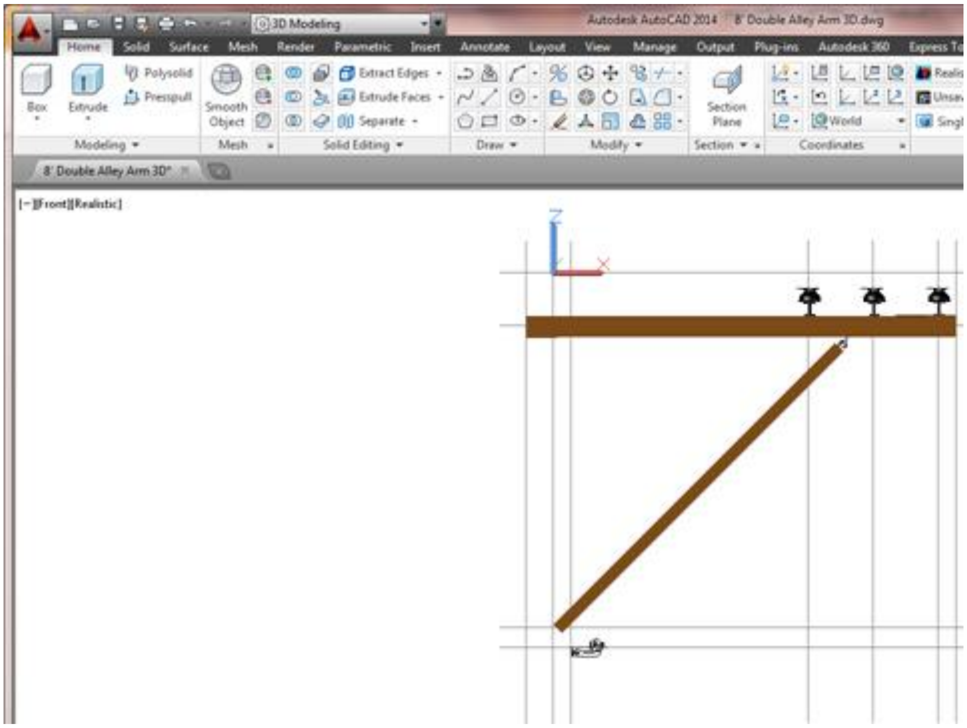
Each of the last two cases, we could not identify a model to use as we found differences comparing CSU standards to AUD template standards. When Model is not found, we will then need to create one. In this case since it refers to an Overhead Pole Head(Alley Arm) Refer to “Autodesk® AutoCAD® Utility Design 2014 – 3D Model Creation for Pole Head” from subscription center White Paper. This White Paper refers to the settings and adjustments required to setup the 3d model for the Pole Head Feature which includes: Block Origin, Radius of the Pole, Ports and lastly, Pole Head.

How do we reconcile when no 3d Model/CU exists for our standard in AUD 2014?

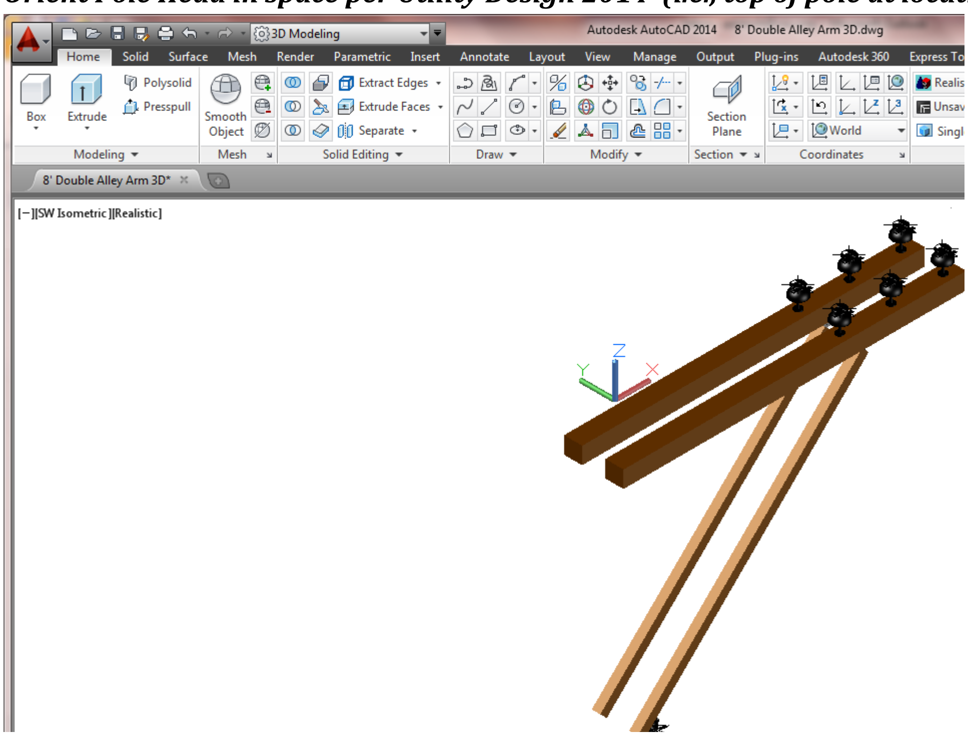
Acquire construction standard for Pole Head



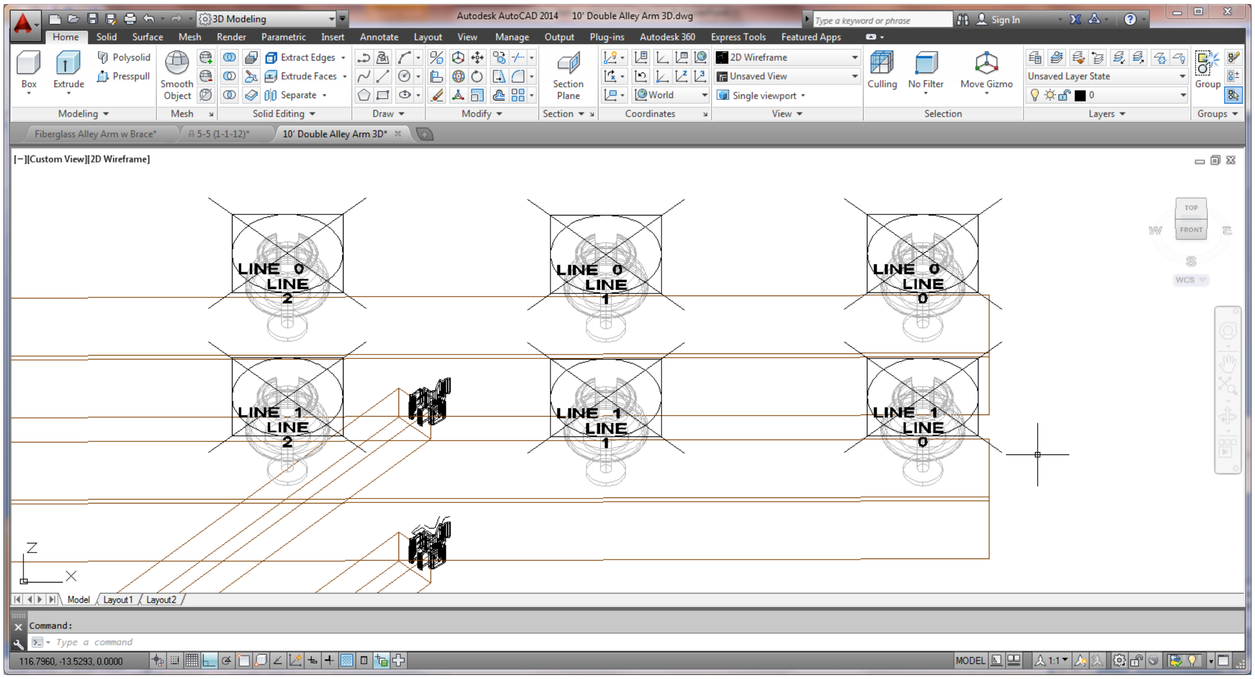
Draw Pole Head to scale (Start with copy of an existing RUS 3D model)



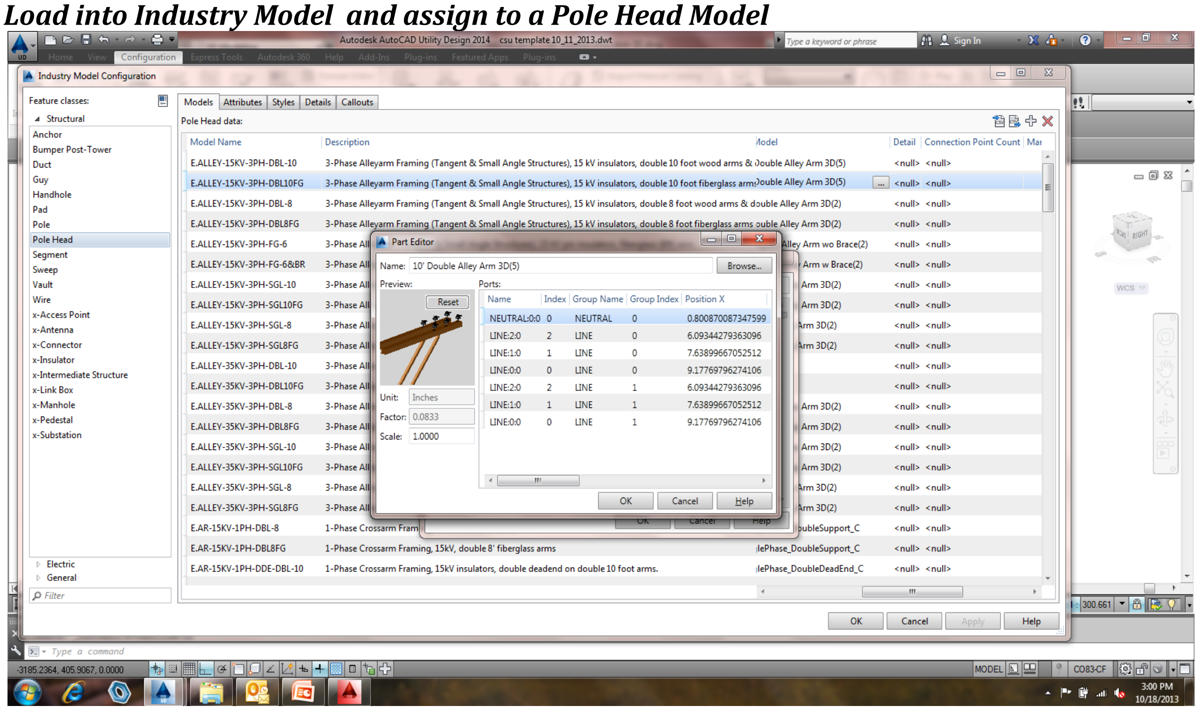
Orient Pole Head in space per Utility Design 2014 (i.e., top of pole at location (0,0,0))



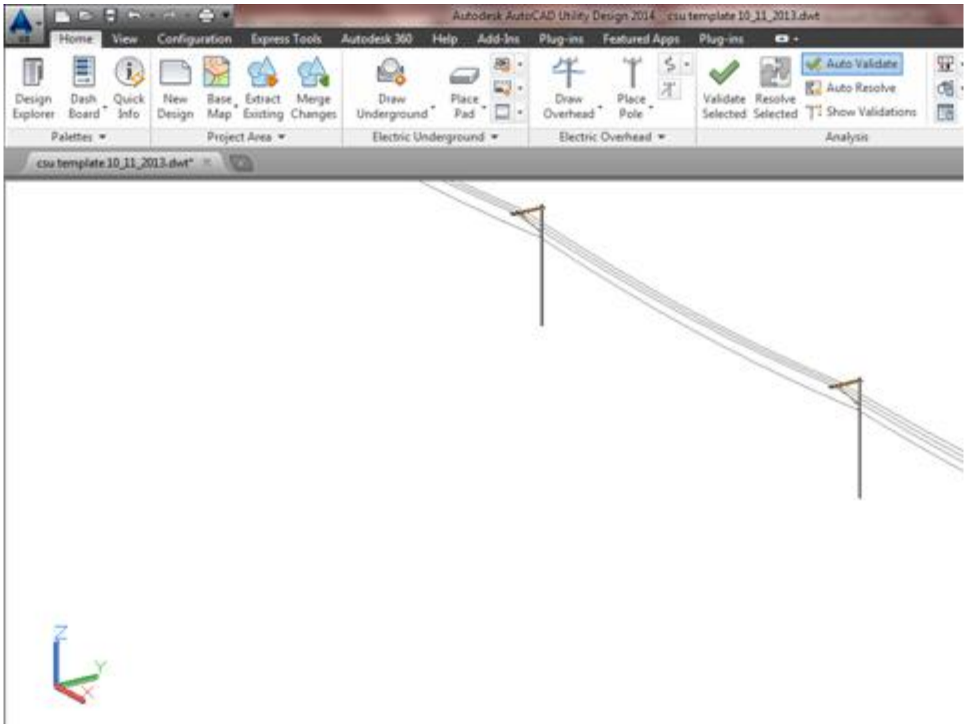
Assign Ports (Copy from an existing RUS model)



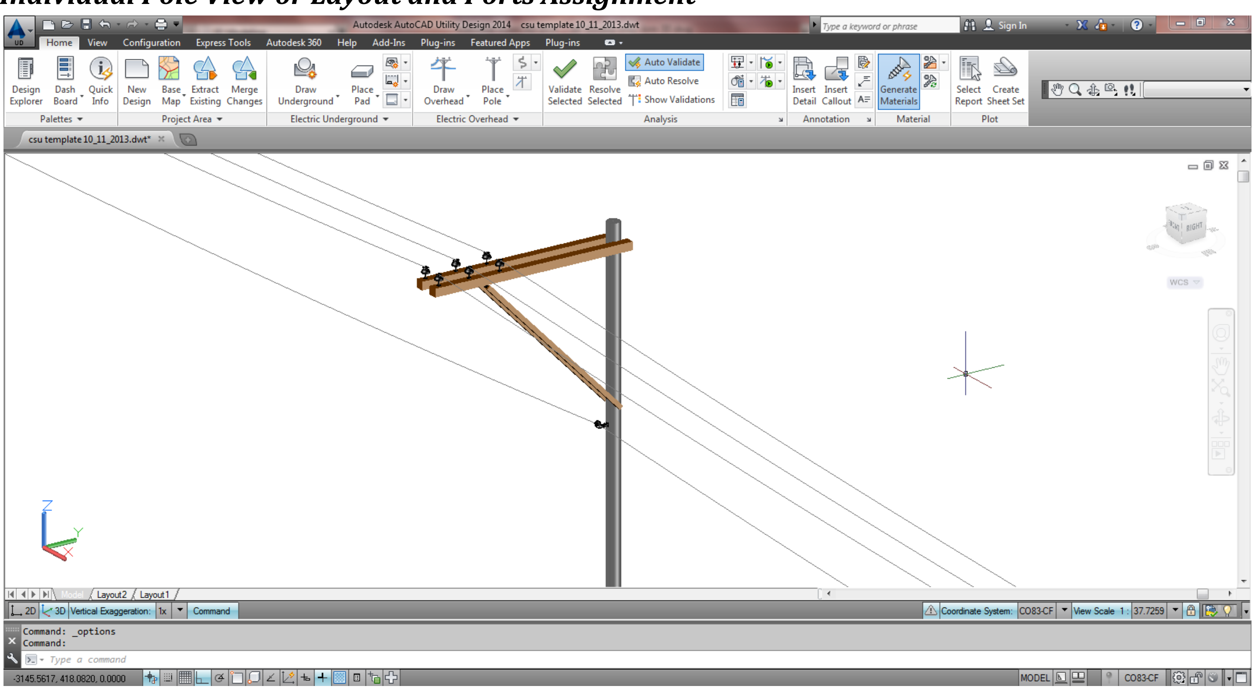
Load into Industry Model and assign to a Pole Head Model



Draw Pole line to test and observe at different scales and views to verify.



Individual Pole View or Layout and Ports Assignment



We iterate through this process for each feature we need to standardize. We chose the polehead example as it is the most difficult and if this can be handled other features setup in the industry model can be handled. Most, if not all, are simpler than the pole with polehead/crossarm.

Learning Objective 2 - Walk through an existing work flow of a utility implementing AUD 2014 Electric.

Consider Looking at Business Processes Critically

We need to identify where inception of business information occurs and events that triggers it. There are existing systems and processes in place, but require business analysis to review work flow. This will tighten our work processes through simplifying workflow and leveraging various systems' strengths for the utility. Resource Management System / Maximo that manages work management, supply chain and warehouse materials.

<u>High Level Information and Flow by Systems We Know Internally</u>

Billing will need information to bill depending on accounts, services and agreements. In CSU's case we need information of streetlights, field inventory installed, specifically streetlights. Billing has specific accounts and recovery for assets in addition to monthly bills. Seem to have separate billing for streetlights and T&M contract work. Pole attachments added later after installation which is a downstream process. Billing needs accounts and types added. If information is staged correctly other systems and consume information and use.

Field Inventory needs ways to categorically group equipment and identify assets. They want a logical grouping of assets tied to a location.

Work and Asset Management (Resource Management System) / Maximo today manages work management, supply chain and warehouse materials. Work Order in RMS is job definition and fits in work flow.
RMS also needs locations to associate equipment to.

Asset Management needs a means to document installed assets and wish to document in digital map books going forward. They are also interested in asset trends analysis.

GIS provides map books of macro information – mostly structures and higher valued assets (transformers) and key access points (vaults, poles) and switching.

Operations Maintenance needs where the equipment exists for service and maintenance and what equipment exists. Operations Maintenance RMS, field inventory, asset management and outage management for installation and repair.

Finance needs capital outlay and job trends and specifics about streetlights and pole attachments rolled up to accounts. They also would like to know cost of assets over long haul (further notion of asset management's trends analysis.

Outage Management appears to use information from GIS and Asset Management.

Understand Our Work Flow

We now put together some critical questions to determine our work flow from business information and records of source and management perspectives.

Record of Source Questions

Where must information record be to support billing?

Where must information record be to support regulatory requirements?

Where must information record be to support field inventory?

Does asset hierarchy of location and equipment below in RMS when it starts in AUD?

Where must assets be installed to document network is energized?

Relationship Questions

How to associate materials to physical structures (Physical)?

How will associate materials to network connectivity (Logical)?

Location Questions

How do we want to identify location by job type?

What information would be most helpful to help identify area and assets?

Identifier Questions

What identifier can we build that has intrinsic value and keeps features unique?

What of previous design elements do we need to carry forward for needed documentation and process that can be used for unique identifiers?

Association/Grouping Questions

Shall we group our features logically?

Shall we group our features physically?

How shall we group our AUD features?

Mapgrid, subdivision name, circuit, equipment to structures?

Learning Objective 3 - Design a conceptual model to support Computerized CMMS, Field Inventory, GIS and Billings Systems.

Our Model we Design from Requirements is focused on Data Attributes and Job Work Flow

Since each requirement will apply to a streetlight AUD feature we will walk through what we need to accommodate a streetlight design.

If we provide a survey of what information is needed by department we find attributes needed by department. We have laid out where they are needed and by which department:

	AUD Streetlight Attributes							
Department	Address	LID	SID	SPID	Rate	XY	Logical	Physical
Billing	Y			Y	Y	Y		
Field Inventory	Y	Y	Y			Y	Y	Y
RMS	Y	Y				Y	Y	Y
Asset Management/GIS	Y	Y	Y			Y	Y	Y
Operations Maintenance	Y	Y	Y			Y		
Finance		Y						Y
Outage Management	Y	Y	Y			Y	Y	Y

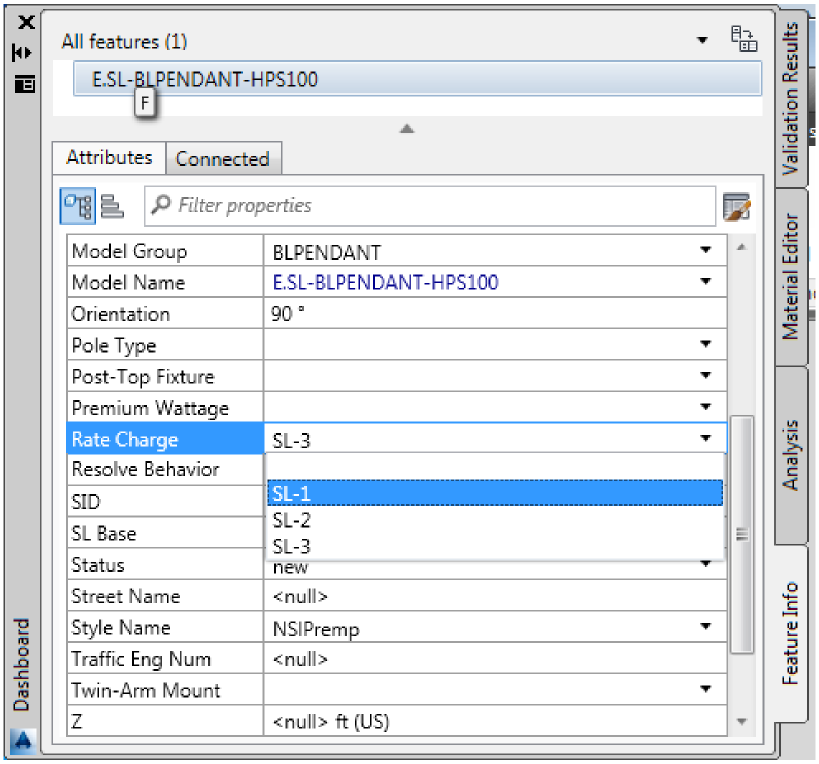
LID: Unique ID

SID: Logical ID with Map Grid

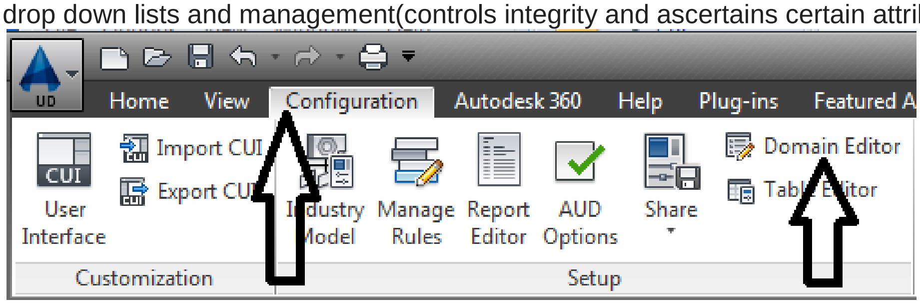
SPID: Account ID

Rate: Charge Code

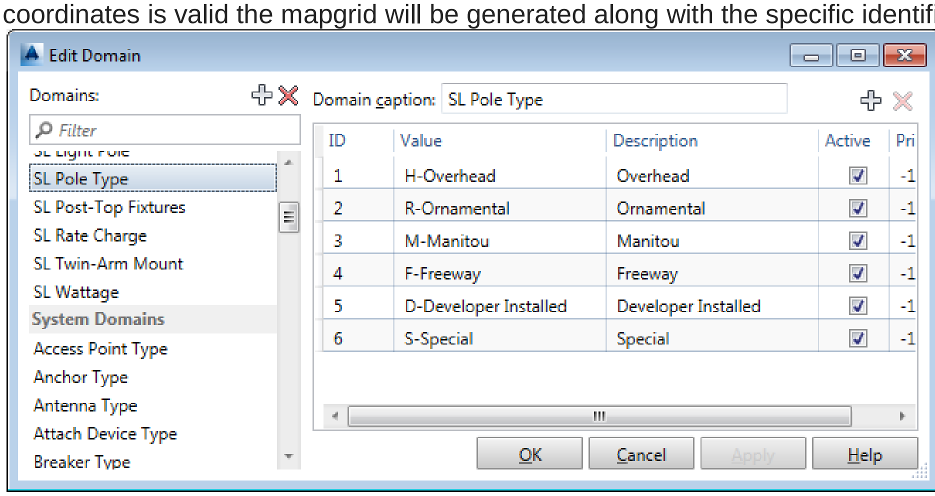
We will start adding attributes of Rate which we use to identify billing along with SPID. Other attributes are also added such as rate and address.



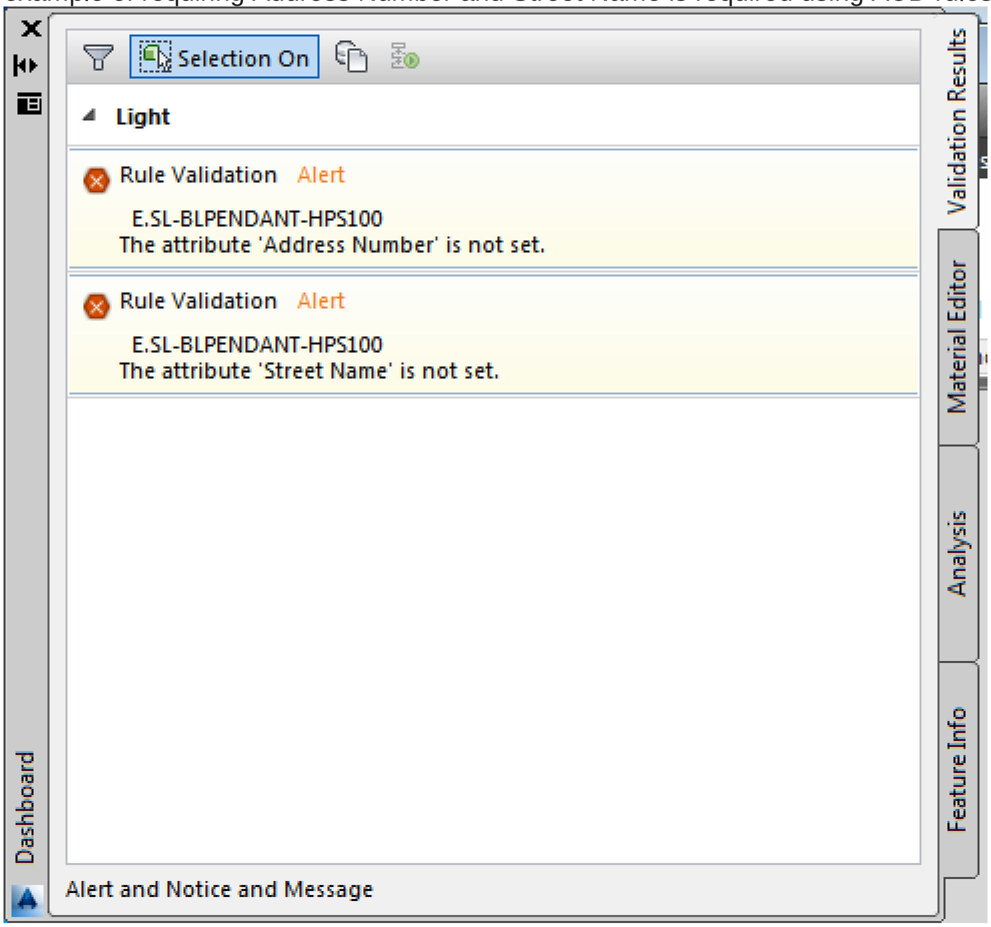
This is a model adjustment using a domain or look up table to help us with attributes selection through drop down lists and management(controls integrity and ascertains certain attributes only are chosen).



We choose the type of pole next. When choosing the Pole Type this is a trigger to identify the LID, our unique identifier attribute. When this trigger is fired, the actual coordinate will be checked. If the coordinates is valid the mapgrid will be generated along with the specific identifier for the lid.



Next we will add address various departments' needs as defined in our Department Attributes Matrix. Entering address information is handled through AUD rules where validations can occur. Here is an example of requiring Address Number and Street Name is required using AUD rules.



Conclusion: How Information Model is Used

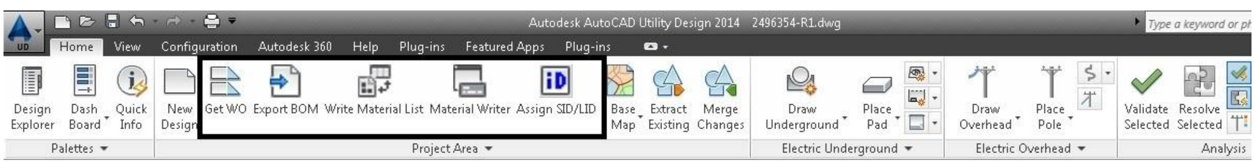
When AUD materials are exported the streetlight address and billing information are sent to the billing system. The location and mapgrid information and the CMMS will receive the location record. Field inventory will receive the billing information and asset information prepopulated for installation. When installed this information is made readily available for the Asset Management/GIS to use through another downstream process.

Learning Objective 4 - Construct and utilize engineering information through downstream and upstream system integration.

Functions Built to Accommodate Business Challenges

For the functions defined that need to store and create the information and identifiers needed for our business needs identified in Learning Objective 2, we need to add commands to AUD to call these functions. The CUIX editor and AUD plugins will do and are used to design the commands needed.

Our AUD Ribbon here shows how we talk to other systems and our custom commands to do so are in the following black box.

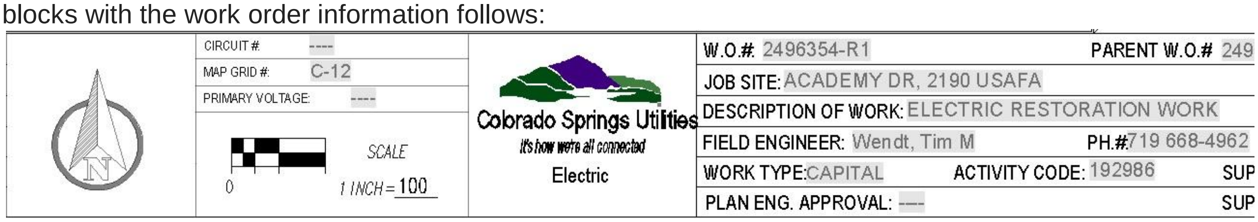


which can be seen more clearly here.

Specifically, we have 5 functions from left to right

Get Work Order (Get WO icon) – how we start the design process. This sets up the job attributes from the work management system.

This will fill our job header information accordingly allowing us to setup a job and work request and produce job prints in several layouts. Each layout has the respective job information – one of the layout blocks with the work order information follows:



Export BOM

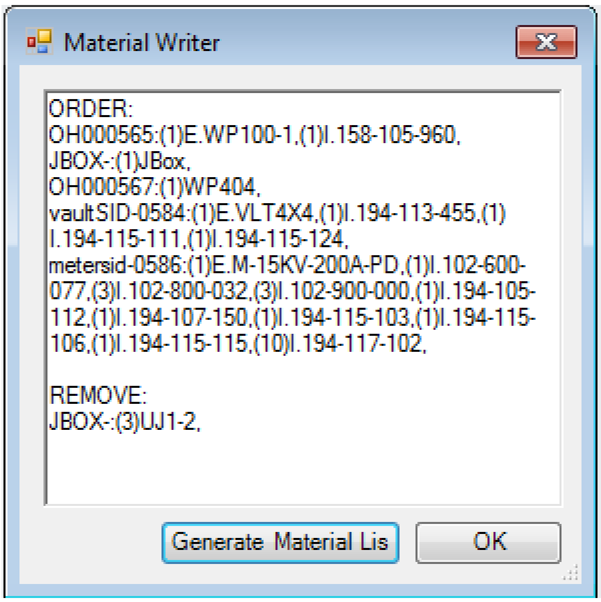
This function sends our bill of materials to Maximo, our CMMS/Operations Database for costing, estimating and installation. The structures become work locations and equipment is associated to the location. Hence, we use our structure, device relationship in AUD and morph it into the Location Equipment relationship in our CMMS.

Write Material List

Prompts the user to insert the specification list with LID identifiers. Similar to the following function this actual provides the list on our page title block for job prints.

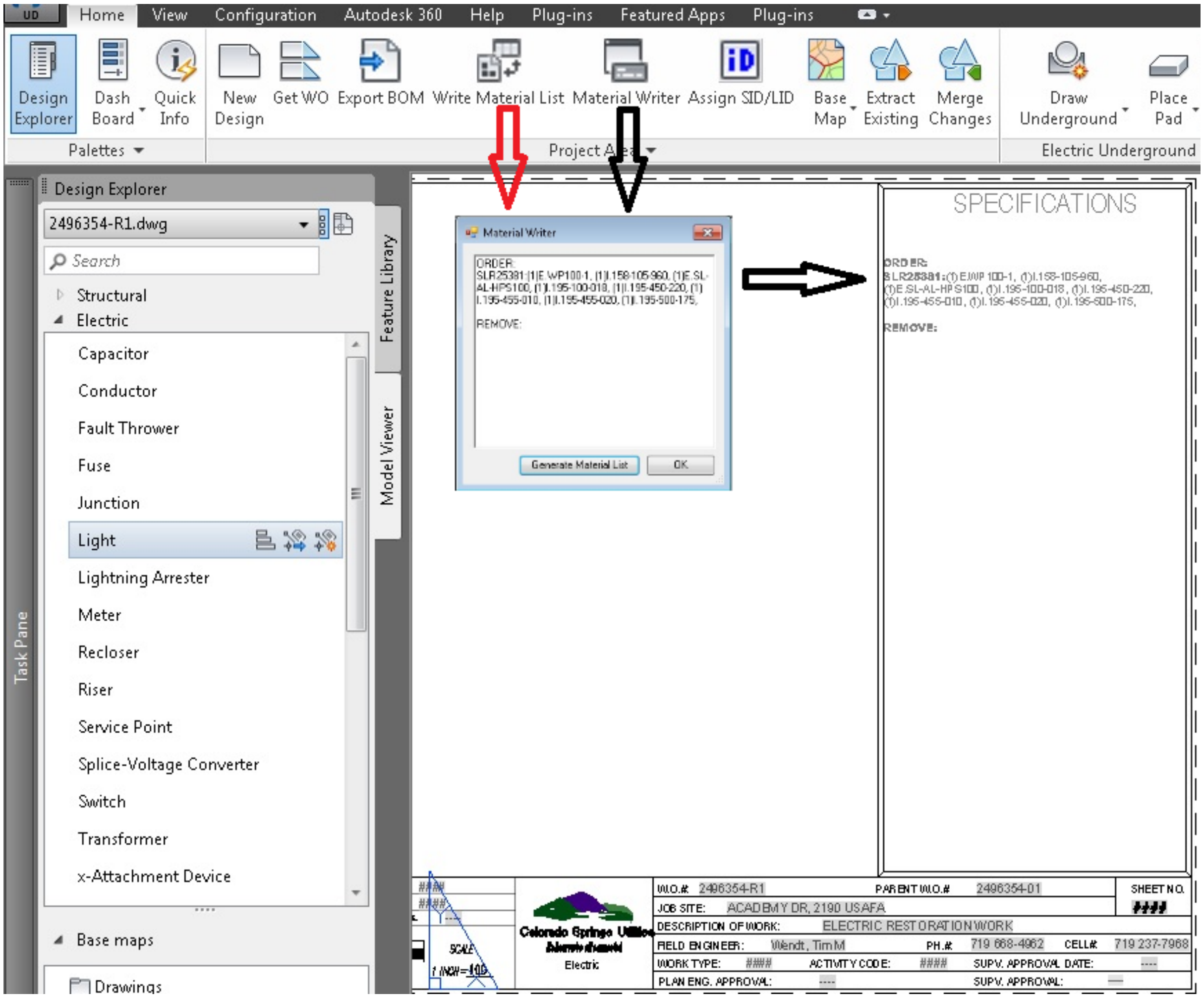
MaterialWriter (This command is not a mandatory requirement: writing to page title block is not mandatory although having spec list content to copy paste into page title block is a mandatory requirement(spec list opens up in list/textbox sample below for this reason))

The output of this command Equipment organized by SID and LID to Order and To Remove



If accepted, generate material list will place this on the page title block.

Specifically to your design job:



Assign SID/LID

Identification attributes for identifiers are now in the model. We intend to build integration “hooks” into the other systems seamlessly meeting our work flow.

When structures are created we dynamically create LIDs for Pads, Vaults, Poles and Streetlights.

We create SIDs identifiers to assist with what, where and unique identification for schematic drawings.

- Underground design we use subdivision or site prefix and increment.
- Overhead design we use the voltage and a mapgrid(3000 x 4000 feet grids used in our mapping system in Colorado State Plane Coordinate System Central)

When adding a work location to a structure LID and SID values are labeled on the design.
Work location block is supplemental information used to group materials to sites.

How We Built Interconnection Between AUD and other Systems Mostly Out of the Box?

We connect our information from different systems together through server side views having Joins between tables in different Oracle databases wherever possible. Also, we read and write the data through Oracle Stored Procedures exposed directly as stored procedures and also as REST and SOAP web services.

We use AUD "Custom Rules" (sample in AUD .Net API) \when device or structure is being validated to determine if SID and LID have been set. We access the custom rules through contexts exposed in the Rules Engine of AUD using Windows Workflow Foundation. The activitycontext methods are used to access objects and reading and write to them. Information on the importance of ActivityContexts when working with workflows in Windows Workflow based solutions can be found here: http://msdn.microsoft.com/en-us/magazine/cc163414.aspx

If not AUD rule calls our .Net written Custom Rule to access the Web Service and Oracle End Points. Action and setting of Values occurs in AUD seamlessly.

An example of using the ActivityContext is here:

```
        protected override DynamicValue Execute(CodeActivityContext context)
        {
            string methodName = MethodBase.GetCurrentMethod().Name;

            ErrorManager.Info(className, methodName, "Entered Method");

            string vaultCode = string.Empty;
            //The feature can be used as is or can be cast to the type of feature
            IFeatureItem featItem = this.Feature.Get(context);

              // This is the entry point to call CSU code that calls their procedures to
              //generate Vault Codes values
            //Call CSU code to generate Vault Codes...


            string sitePrefix = String.Empty;
            sitePrefix = featItem.GetAttribute("SITEPREFIX").Value.ToString();
            //note you will have to use the proper name.
            ErrorManager.Info(className, methodName, "SITEPREFIX feature attribute value
            = " + sitePrefix);

            CSU_IdentifierGenerate idgenerate = new CSU_IdentifierGenerate();
            //add coordinates here
            vaultCode = idgenerate.GetVaultCode(sitePrefix);
            ErrorManager.Info(className, methodName, "Vault Code value = " + vaultCode);

            idgenerate = null;
            //return value to the AUD Rules
            ErrorManager.Info(className, methodName, "Exiting Method");

            return vaultCode;
        }
    }
```

Integration and Rules to Other Systems:

We can use our AUD Feature Identifiers in part as aspects of other systems.

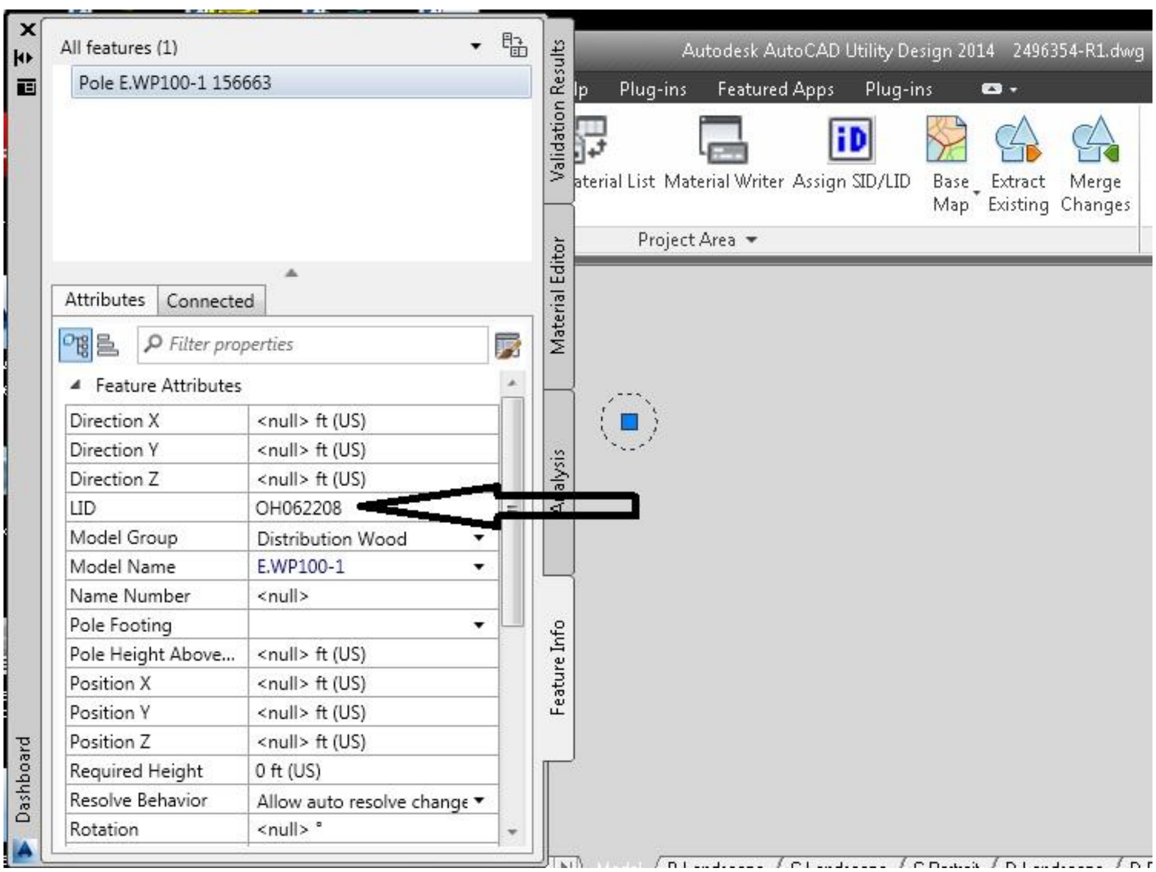
LIDs

Lids are location identifiers indicate where a physical location exists, i.e. the hole and location and not the pole or physical asset.

Example 1: Overhead Poles and Location Identifiers

There is a distinction between an asset and its physical location where it exists. We want to define both the asset and physical location. In the case we are adding and overhead pole, we generate the next available number for a pole structure. We implemented a naming convention of OH(for overhead) and then generate the next number. For example the last pole created is OH062207, we will next generated the LID for the Pole as OH062208.

LID = OH062207, OH062208 = OH + Series (generated)



Example 2: Streetlights and Location Identifiers

When a pole type is chosen we use the pole type to generate the next Location Identifier for the pole type. If last number used is 26001 with pole type M which would be SLM26001, the next pole type we choose of M or other type(i.e. H) would generate the next LID, SLH26002. This is set to the LID attribute in our industry model.

LID = SLX26001, SLM26002 = SL + Type + Series (generated)

SIDs

SIDs are Site Identifiers group features logically and have location and can have network information.

Example 3: Underground Vaults and Site Identifiers

When a siteprefix / subdivision is entered as an attribute a vault code is created that uses the siteprefix as input and returns the SID identifier and is set to the SID attribute in our industry model. This helps determine where the underground structure(underground vault or padmount) is located.

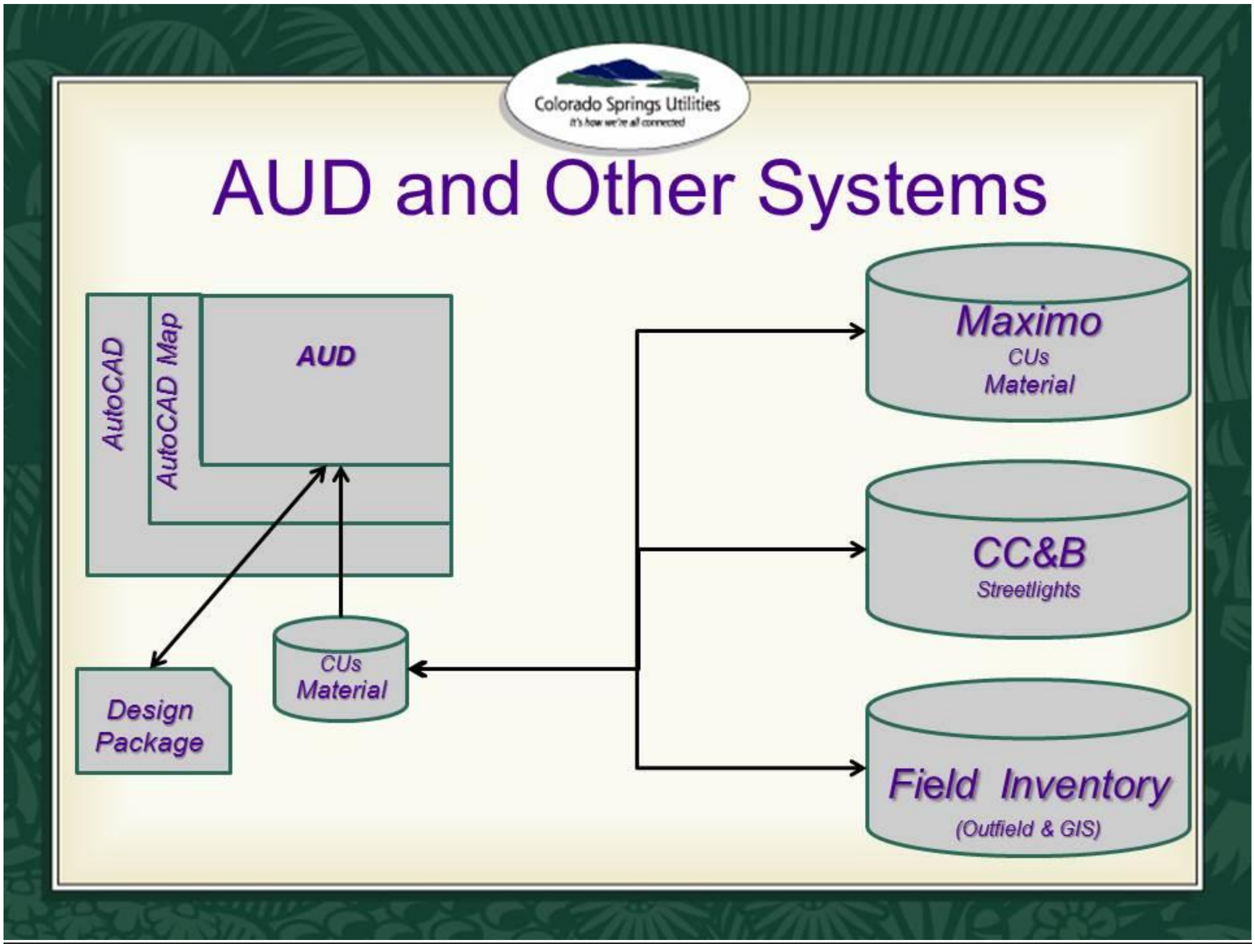
SID = CVR-1, CVR-2 where Siteprefix = CVR + Series(generated)

Example 4: Streetlights and Location Identifiers

For switches the voltage of the switch is used in conjunction with the x,y coordinate to identified the map grid. The sid in this case is voltage-mapgrid.

SID = Nominal Voltage(12) + Mapgrid(from XY) + Series(generated)

Information Flow from AUD to Other Systems



As these features are created and their respective identifiers are generated and stored in the industry model we have defined in Learning Objective #3 in the design of our information model with SID, LID and streetlight Attributes, we know use our custom rules and .Net code to send information to other systems through various technologies.

Configuration Parts Objective #3Parts:

Configuration of AUD Rules engine to provide a context(like an event on a feature(which is a device or structure in AUD) and logic for validation, ordering, labeling(callouts) and assist with identifier generation must be setup to call a plugin.

.Net Plugin (plugin model to simplify development and deployment)

- Interacting Accessing data via Autocad Map FDO Providers (for our material list)
- Native Oracle .Net Providers for access to other Oracle Database systems Reads and writes with Web Services(using REST and SOAP)

- AUD API to access our industry model with model attributes and custom attributes.
- Ability to quickly couple and decouple services between different endpoints(which in turn means different systems versions and integration points)

Many AUD Representations of Same Feature

For example to handle a feature in different contexts, let's visit a streetlight.

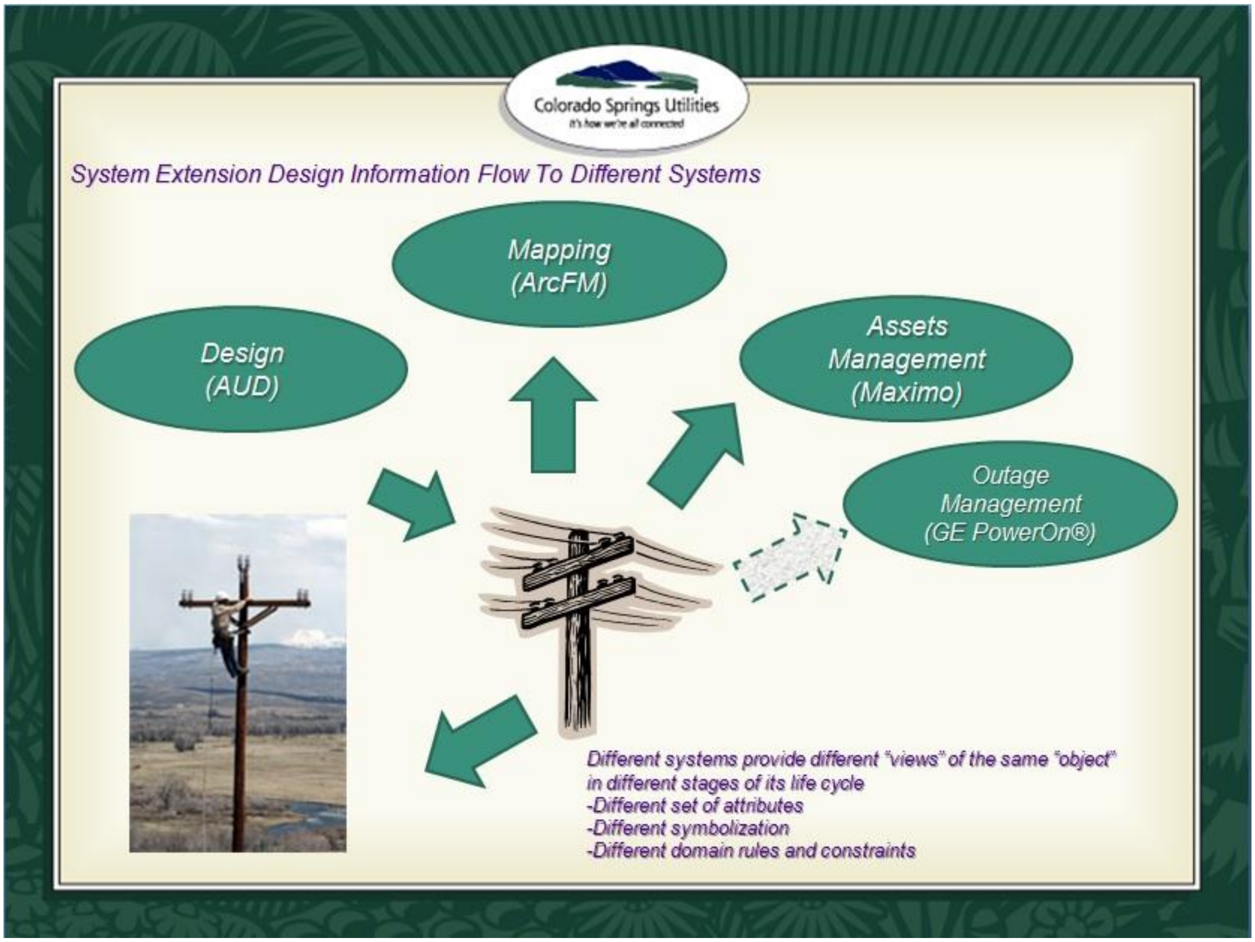
<u>A streetlight is</u>:

- an asset to asset management;
- a maintenance item to work Management;
- a mapped point feature to Mapping;
- an item to Bill that must have a rate class and type associated;
- an electrical device that can be attached to a pole or unto itself;
  (a structure or a device-discussed device and structure in Learning Objective #1)
- an item of concern that changes through maintenance and could be subject to an outage.

Since we need to accommodate all of these needs, we take a least common denominator, inclusive approach of all states of streetlight and workflow must be supported by the industry model, required data inputs, updates and required downstream systems.

The least common denominator approach of reviewing all systems and determining business requirements can be supported will require all information to be stored, to have events "triggered" at the appropriate time, and be "competent" [data] at time it must go downstream to the other system. It must maintain its tie to systems along the way where the tie is relevant.

AUD Feature Information to Other Systems



The Flow of an AUD feature

The downstream approach of the streetlight feature will flow downstream to each of these system with added attribution, data input, validation and automatic generation of identifiers connected to other systems(GIS, Maximo and Field Inventory) acting as the initial record of source of assets flowing to the GIS, Maximo and Field Inventory with attribution enforced by the industry model's designed referential integrity, AUD's rules and process adopted to support each system.

Key Benefits

Each System's Strength is Leveraged

Work, resource management in RMS that includes costing and materials management. Fielding inventory identification and asset type, billing codes to aggregate components by account caught early in the design process. In the downstream processes, this process and attribution is sent to various systems to become the record of source based on system's purpose in organization: Field Inventory, Billing and Resource Management. The upstream processes are maintained as BOM is tied to a work order and costing can occur through pushes downstream and processes that are run to tie job, costing and materials reservation dynamically.

Survey and Design Systems Solution Once and Do It Well

A robust implementation of the design process must encompass work flow analysis and process review to simplify processes and support business needs. This eliminates duplication of data and leverages various systems' strengths. Early identification of components (structures and electric features and their many states) yields excellent insights into the many states and representations a component must have to support upstream and downstream processes. We used a comprehensive, least common denominator approach and inquired on supported needs to accomplish this in our process.

Use Core Product and Subscription Where Possible: Keeping It Simple and Configure

Leveraging out of the box functionality and keeping implementations in the configuration space versus customization has reduced Design Tool Implementation life cycle time and costs. In short, this reduces cost of ownership and allows for upgrades to occur. Also, maximizes our present subscription as Design Tool releases appear to be more and more common as AUD is a main stream product.