AUTODESK UNIVERSITY

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The ‘I’ in Infrastructure: Using Civil 3D & Navisworks for Asset Information Exchange

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Learning Objectives

- Add rich data to an infrastructure model
- Configure the Navisworks COBie Extension based on client asset information requirements
- Set-up and manage property dataset definitions
- Use several new product features in AutoCAD Civil 3D 2017

Description

Adding asset information to Infrastructure BIM projects.

While the delivery of asset information on Building projects is becoming well understood the same is not always true for Infrastructure projects.

This class will look to change that.

Using real clients requirements for common infrastructure assets the class will demonstrate how property datasets can be structured for asset information delivery.

The class will show how standards can be managed at a company level so that all projects deliver consistently structured data and how the property data of several common Civil 3D objects can be extended to allow client specific attributes to be added to designs as they progress.

The class will then show how this data can be passed downstream to Autodesk Navisworks and how the Navisworks COBie Extension can be configured to deliver asset information either in COBie format as well as showing how the tool can be used to deliver based on bespoke client requirements.

Your AU Expert

Tom Hughes is a project technologies consultant for Mott MacDonald as part of a global Project Technologies Group. Tom specializes in the UK Level 2 BIM requirements, Common Data Environments, infrastructure BIM and Autodesk best practice. Tom’s role means he works on a wide variety of projects both for key clients in the UK and around the globe. Tom is a member of the Institute of Civil Engineers, a Building Research Establishment (BRE) Academy BIM member and part of the Autodesk futures portal for infrastructure. You can find him online @bimostb

Asset Information from an infrastructure perspective

This class is looking to change your perspective about 'Asset Information' for infrastructure projects.

Some common misconceptions

"Civil 3D can't produce asset information"

"Clients aren't asking for asset information"

"COBie isn't suitable for an infrastructure project"

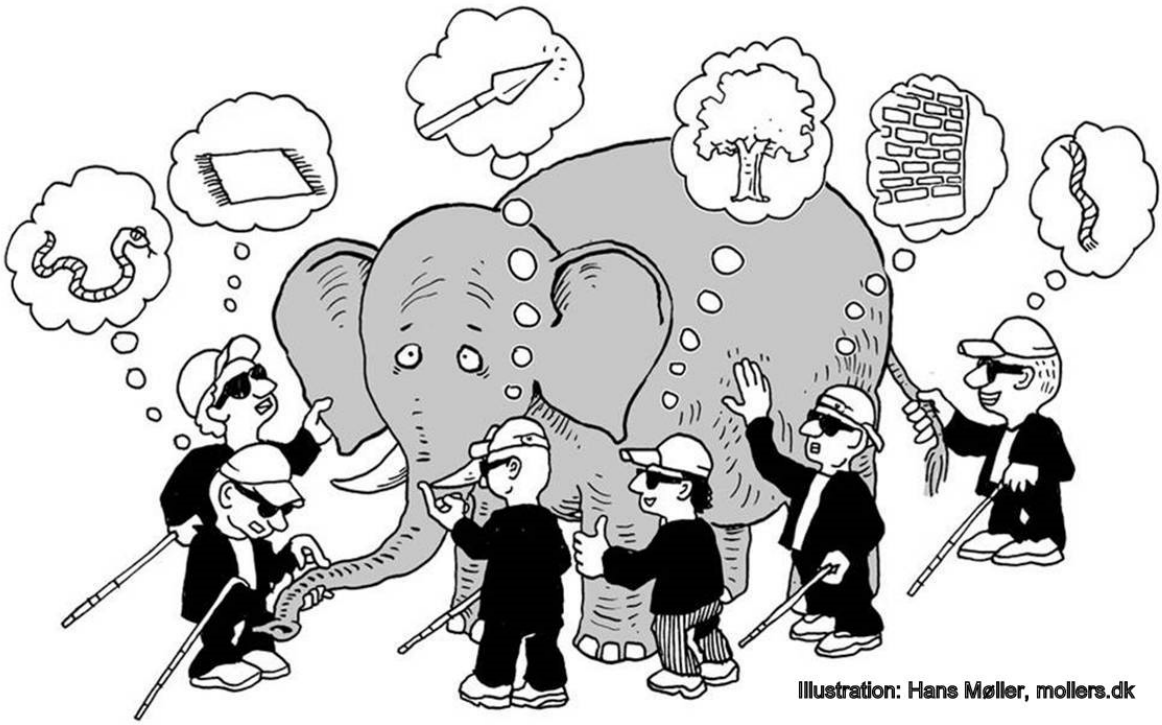
And many more…

Hopefully though-out the course of this class I will be able to dispel some of these misconceptions and open up some exciting opportunities to add considerable value to your Civil 3D Infrastructure projects.

Asset Information 101

Before exploring how Civil 3D can be used to produce and manage asset information it may be worth going back to basics.

'What actually is asset information?'



THE BLIND MEN AND THE ELEPHANT

Basically there are many different definitions depending on your perspective.

However as a Civil 3D user the way I like to think of 'asset information' is as a collection of data that will add value to the operation and maintenance of a built asset by answering questions about the design and construction.

Or to ground that in context; imagine that you are managing a road 20 years in the future and you have a question like 'I wonder if this culvert can take an additional 1.5m3/s of flow?' Or 'I wonder who manufactured these road barriers and what is there expected service life?'

THE FUTURE

ASSET INFORMATION

Good quality, structured asset informing is like having a time machine that allows the future you to jump back to the design, construction or potentially any other maintenance work that has been carried out in the past, and get answers to these and a whole range of other questions.

It should be clear, the ability to interrogate asset information and get answers to a whole range of questions is extremely valuable to the owners and operators of infrastructure assets. It allows them to make informed decisions and avoids the need to spend time and money on investigations to re-discover information that was part of the original design or construction.

Asset Information Requirements

With a basic understanding of what asset information is and why it is valuable, the next step to adding rich asset information to infrastructure models it to understand the 'Asset Information Requirements'.

The asset information requirements are simply the information that is required for each asset on a given project.

Unfortunately this is often the first stumbling block when it comes to creating asset information as it is not always clear what information is required, how it should be structured, who should produce it and how it should be exchanged.

In my opinion this confusion is a result of several different perspectives.

Asset Operator/Maintainer's Perspective

In most cases the asset operator or maintainer will have a very good idea of the information they would like to know about the asset in order to assist their operations.

As well as knowing what information is required, the asset operator or maintainer may also have a good understanding about what data structure their asset management systems are using and how best to exchange the information.

A problem is that in most cases these requirements are not documented or communicated to the design or construction team and in many cases there is no operator or maintainer in place when the asset is being designed and built. They exist, but only in the future, and by the time they have been appointed the design and construction has already taken place.

There is also a problem with the 'traditional' hand over of O&M information

HARD COPY O&M FILE

'DIGITAL' O&M FILE

Valuable information is often buried away in the hard copy O&M file. These is also a limitation that the hard copy only displays what you can 'see' so any attribute data is lost.

Even when there is a digital copy of the O&M file this is usually limited to drawings and documents. Imagine it's 2036, do you think you will be able to even find a CD drive let alone open a Civil 3D 2016 model?

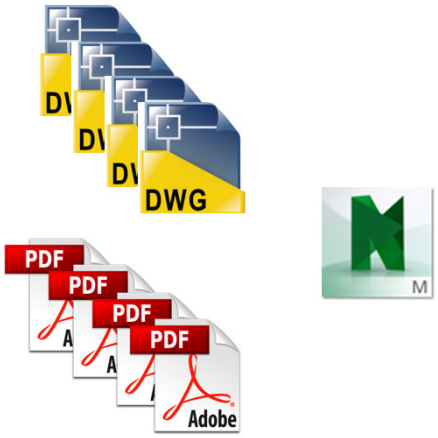
Designer/Contractor's Perspective

In most cases the designer and the contractor are using BIM tools to plan, design and construct the asset.

DATA RICH INFRASTRUCTURE MODEL

This means the opportunity exists to add rich data to models, and this class will show you how. However without clear requirements it is difficult to know what may be required, how it should be structured and what format it should be delivered in.

As a result asset information is often overlooked, with projects focusing on producing a coordinated 3D design model and associated construction drawings which are much more easily defined.



THE FOCUS

THE OVERLOOKED OPPORTUNITY?

Client's Perspective

The client has the greatest vested interest in seeing information passing from the design and construction stages of the project to asset operation and maintenance.

Clients often face the issue that they may not always know what information could be valuable to assist the operation and maintenance of an asset, and they may be unaware about the information that could be created as part of the BIM process.

Even though clients may not know what they need, or what is available, the influence of 'BIM' on the construction industry is that client are looking to understand these requirements and this opportunity.

Increasingly we are seeing clients asking for the handover of asset information in COBie or other formats. With some clients even starting to define their asset information requirements and include these it the contracts for design and construction.

Opportunity

As Civil 3D users the opportunity is to better understand the capability of the software to produce asset information and how it can be used as part of a workflow to create a structured information delivery that is suitable for handing over to support asset operation and maintenance.

By being aware of this capability we are better able to assist our colleagues in constructive discussion with our clients in order to create a good understanding what information can be created as part of the BIM process.

The production and delivery of structured asset information is a value added activity. This means there is the real potential to increase the scope of chargeable work or to use this knowledge and capability to differentiate your companies from that of your competitors.

Also by being aware that clients are now starting to ask for asset information as part of design and construction contracts we can make sure that we ask 'that question' early and set up our models so that information can be added as the design progresses. The last thing anyone wants is to find that 'We need to produce a data drop' in the last week of the project.

COBie (or not COBie)

At a basic level in the building sector the challenge of connecting the asset operator and maintainer requirements to the design and construction team is managed through a common set of assent information requirements and a common data structure know as COBie (Construction Operations Building Information Exchange).

In coming to understand what COBie is I have found it useful to think of it in two parts.

The first part of COBie is a set of minimum information requirements for operating and maintaining a building.

The second part of COBie is a standard data structure for exchanging asset information.

An analogy I like to use is shopping for groceries. Think for the asset information requirement as the grocery list and the BIM model as the store. In this analogy the groceries are the asset data, and the shopping cart is the data exchange format.

SHOPPING FOR DATA

The problem is that 'Infrastructure' is a very broad range of project types (Transportation, Power, Water, Environment etc.) all of which have widely different information requirements. This means that there isn't a basic set of requirement that can be applied to all projects. If you want to continue the shopping analogy think of trying to shop for enough ingredients to cook every meal on a menu rather than a single dish!

Not having a clear set of asset information requirements is one reasons that people may assume that COBie isn't suitable for infrastructure. Many people will take a look at COBie and assume that it's for Buildings.

However providing you can establish the asset information requirements for your particular asset type COBie is actually quite a flexible data structure.

One important thing to understand about the COBie data structure is it an open format that can be delivered using an Excel workbook with multiple sheets displaying different information.

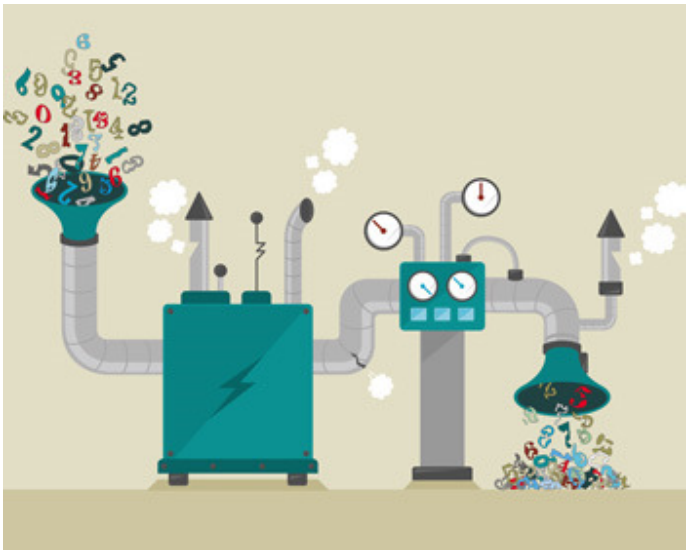
This is valuable as it means that the ability to interrogate the asset information doesn't depend on the asset management system that may be in use years after design and construction. Even if no specialist asset management software is being used the COBie spreadsheet can be opened and all of the information viewed and interrogated.

COBie is by no means the only way of structuring asset information. In the building sector many clients are using Computer Aided Facilities Management systems such as Archibus, IBM Maximo and Autodesk Building Ops, all with sophisticated data structures and the ability to integrate 3D models into asset information. What COBie provides is a low tech way of getting value from asset information.

The reason that this class has covered COBie is that in the UK our national BIM mandate, which came into effect in 2016, makes a COBie format data delivery a mandatory requirement for all centrally funded (UK Government) construction projects.

As an engineer I like solving problems and so earlier this year I set about understanding how Civil 3D could be used to create a COBie data drop.

However by working through the problem of producing COBie format data I came to realize that providing you can define the asset information requirements (Data to put in) and the required structure of the information exchange (Data to take out) that a combination of Civil 3D and Navisworks can be used to create virtually any asset data delivery.



DATA IN – DATA OUT

This class looks that the ways in which I've used Civil 3D and Navisworks to deliver structured asset data, and will show you the steps to do the same thing, regardless of your asset information requirements or you data structure.

Real world example of an Asset Information Requirements

To illustrate this process I'm going to use a real world example taken from a proof of concept project I did as part of a Civil 3D gunslinger event in January 2016.

The Environment Agency in the United Kingdom are a key client for Mott MacDonald. Under a 5 year framework Mott MacDonald are one of several consulting engineers providing design services for the Water and Environmental Management framework.

A typical project delivered under this framework is the design and construction of flood defenses to reduce flood risk.

The Environment Agency is an 'intelligent client' supported by the UK BIM Task Group, a central body responsible for supporting clients adopt BIM in the UK. As part of their implementation of BIM and the digitization of their asset management processes the Environment Agency have developed a set of asset information requirements as part of their ongoing Creating Asset Management Capability program.

During the Gunslinger I took the design of flood defense wall and the Environment Agencies CAMC Asset data requirements and worked through the following process.

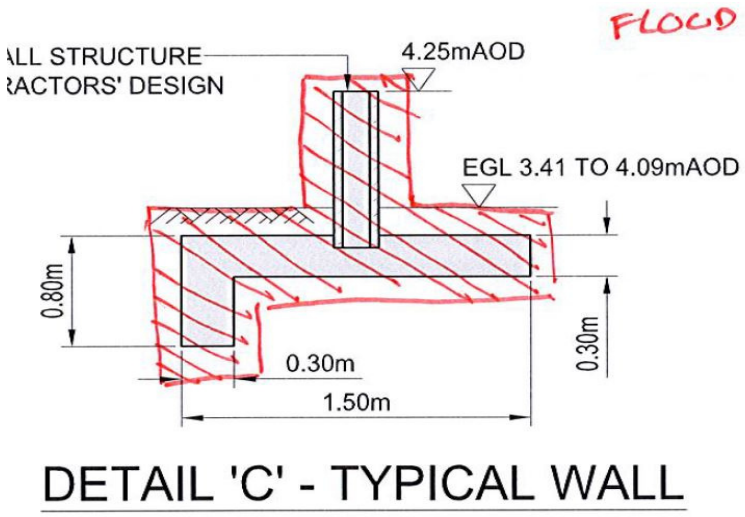
Adding Asset Information to a Civil 3D model

Step 1 – Background Information

Client: Environment Agency (UK)
Asset Information Requirements: CAMC
Asset type: Flood Defense Wall

Name	Value	DataDrop	DPoW WorkStage	Unit
current SOP		LOD1	Brief	n/a
current SOP date		LOD1	Brief	date
asset type		LOD3	Definition	n/a
asset subtype		LOD3	Definition	n/a
description		LOD3	Definition	n/a
location		LOD3	Definition	n/a
primary purpose		LOD3	Definition	n/a
asset owner		LOD6	Handover	n/a
asset operator		LOD6	Handover	n/a
asset maintainer		LOD6	Handover	n/a
data owner asset ref		LOD6	Handover	n/a
alt asset ref		LOD6	Handover	n/a
asset name		LOD6	Handover	n/a
comments		LOD3	Definition	n/a
secondary purpose 1		LOD6	Handover	n/a
secondary purpose 2		LOD6	Handover	n/a
operational requirement		LOD3	Definition	n/a
replacement cost		LOD3	Definition	Pounds
replacement cost assessment date		LOD3	Definition	date
[illegible]		LOD6	[illegible]	n/a

CAMC ASSET DATA REQUIREMENTS – FLOOD DEFENSE WALL



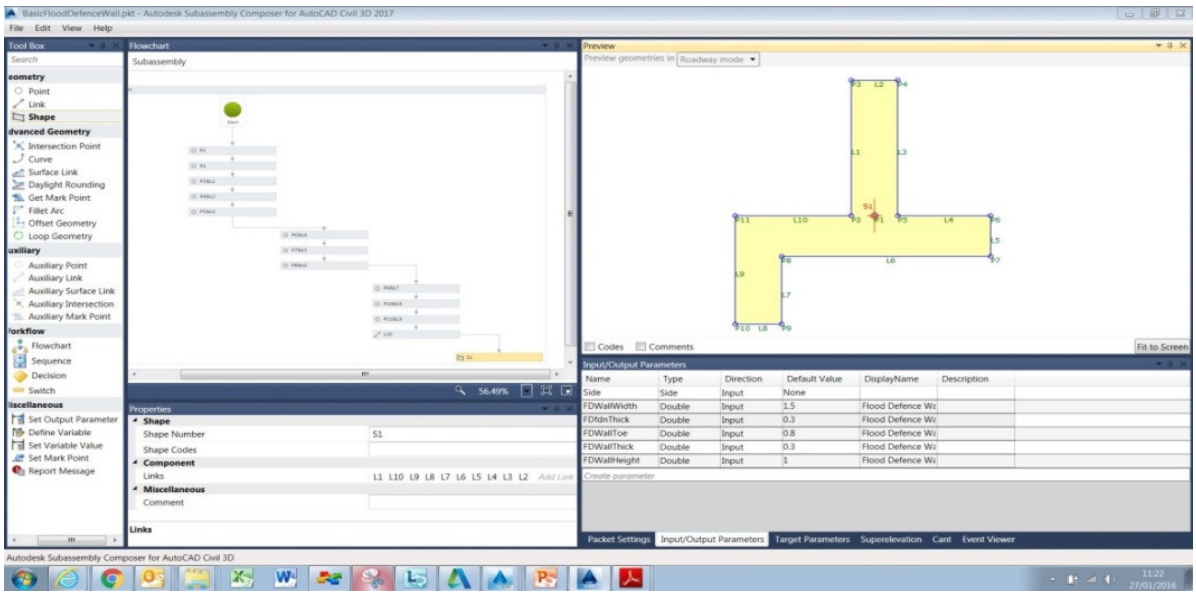
ENGINEER'S DETAIL

Step 2 – Creating a sub-assembly

Creating a sub-assembly is nothing new in Civil 3D and there are plenty of great AU classes that will explain the process better than I can, but there is a reason I have included this step in the class.

For many objects the Civil 3D sub-assembly is the reusable graphical definition. In the case of the flood defense wall I didn't have an existing sub-assembly that did what I wanted so I quickly made one, effectively defining the graphical element of the deliverable.

Creating a new sub-assembly, and any existing library of existing sub-assemblies, should be a trigger for an opportunity to identify what asset information requirements for that object could be.



A SIMPLE SUB-ASSEMBLY

Step 3 - Creating Property Sets for Asset Data (New to Civil 3D 2017)

The ability to create and assign custom property sets was a new function added to Civil 3D 2017 (and subsequently added to Civil 3D 2016 in productivity pack 2). This functionality opens up a whole world of possibility when it comes to adding rich data to infrastructure models in Civil 3D.

The following Autodesk knowledge article provides full details of creating property sets and is a great resource for anyone looking to explore this capability further.

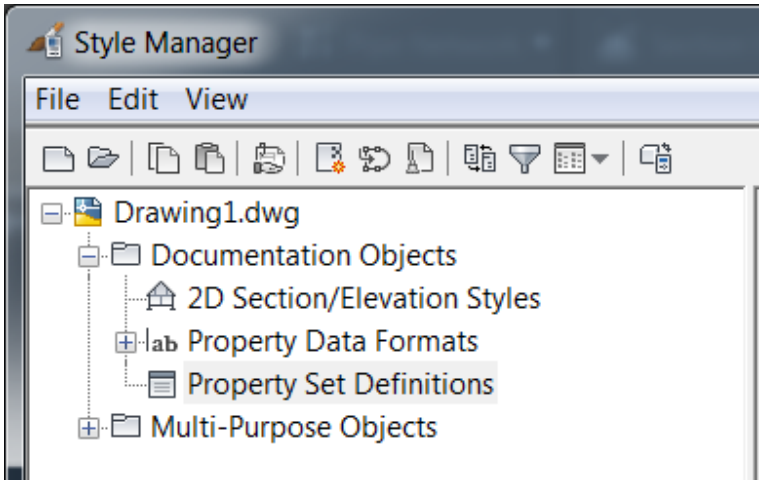
https://knowledge.autodesk.com/support/autocad-civil-3d/learn-explore/caas/CloudHelp/cloudhelp/2017/ENU/Civil3D-UserGuide/files/GUID-FF05147B-A17B-4078-8B62-C40AE50255A9-htm.html

Step 3.1 – Open Style manager

In a new drawing (I'll explain why later) open style manager.

Click Manage tab ➤ Property Set Data panel ➤ Define Property Sets  Find.

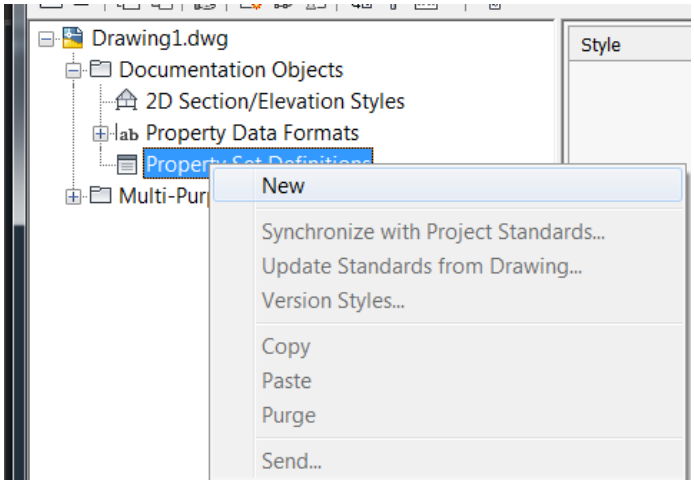
Or



STYLE MANAGER

Step 3.2 Create Property Set Definitions

Right Click> New

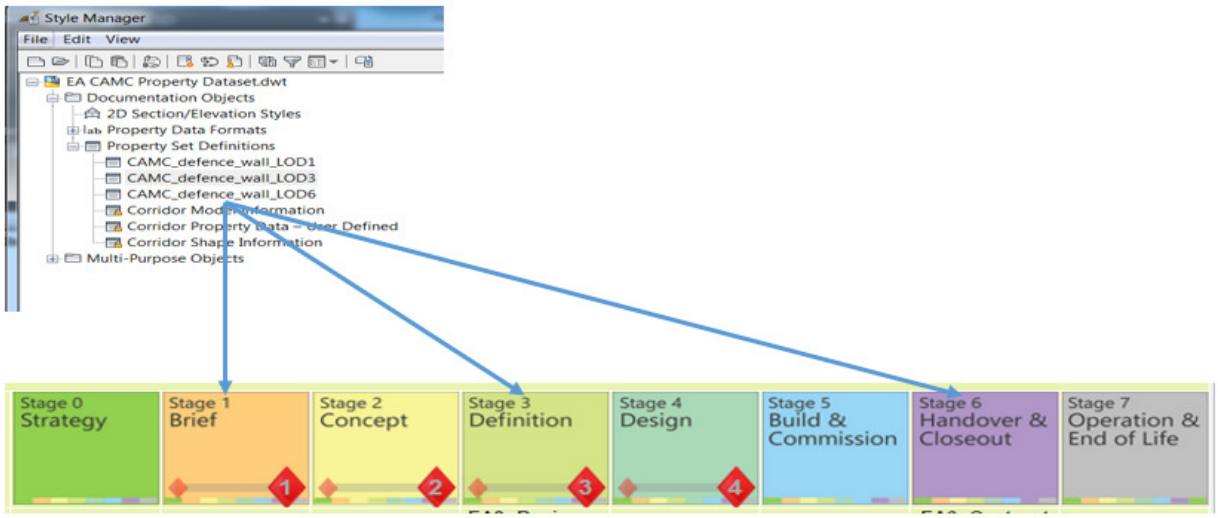


NEW PROPERTY SET DEFINITION

At this point is it is important to consider how the data you want to add to the model should be structured.

Based on the Environment Agency requirements I structured the property sets to match the 3 data drops that are required across the project cycle.

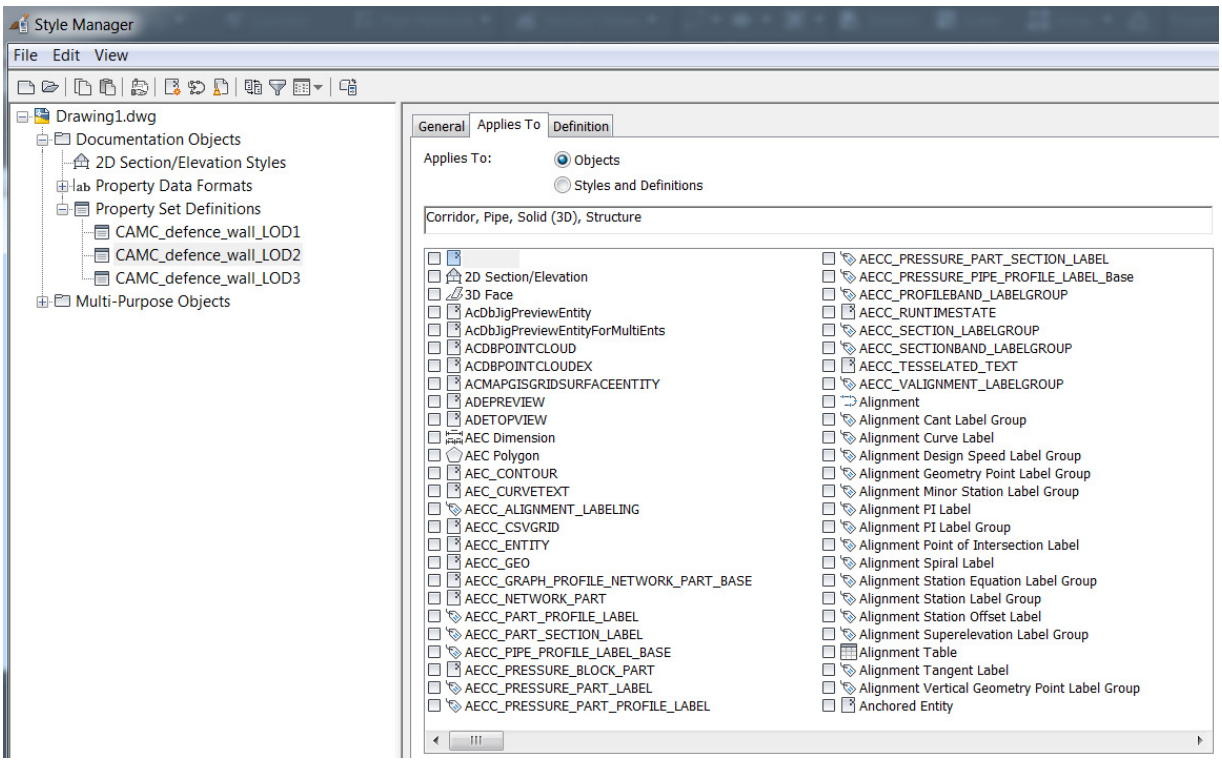
- CAMC_defence_wall_LOD1
- CAMC_defence_wall_LOD3
- CAMC_defence_wall_LOD6



PROPERTY SETS DEFINITIONS ALIGNED TO WORK STAGE DATA DROPS

This means that its it clear who should be supplying what information at what stage of the project – A key part of any successful BIM process.

Step 3.3 Assign property set definitions to Civil 3D Objects

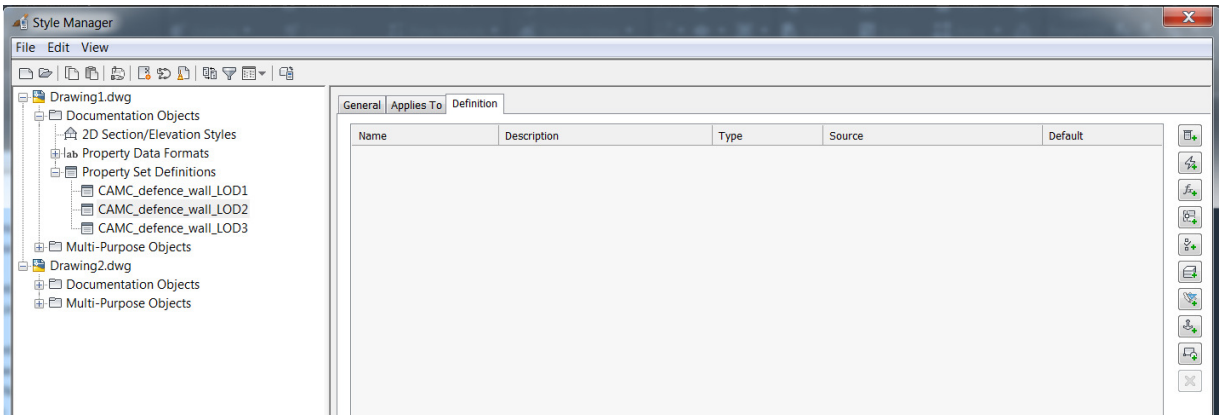


'APPLIES TO' TAB

For each property set definition you can select what object the property definitions should apply to. For asset information I have found Corridors, Pipe, Solid (3D), Structures useful but there many more object types available.

TIP: To avoid affecting application performance, it is recommended that you narrow down the list of objects to which the property set applies.

Step 3.4 Create Definitions



'DEFINITION' TAB

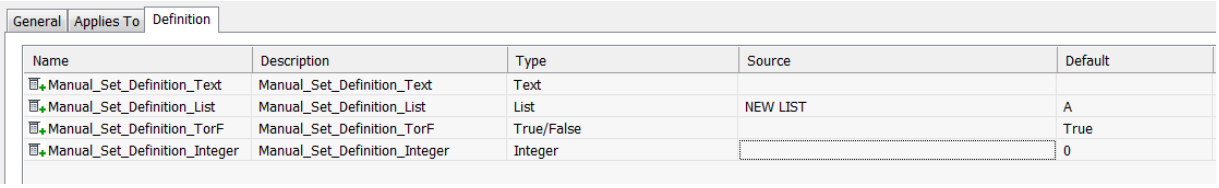
On the right hand side of the definition tab there are several buttons that allow you to add definitions to the property set.

There are several types of definition you can make. The descriptions below covers a few key ones that I have found useful when setting up Property Data Set Definitions for asset information.

Add Manual Property Set Definition

The first button, 'Manual' property set definition is very versatile.

When adding a manual definition it can take several types. Again here are some of the ones I have found useful and some examples of how I have used them.

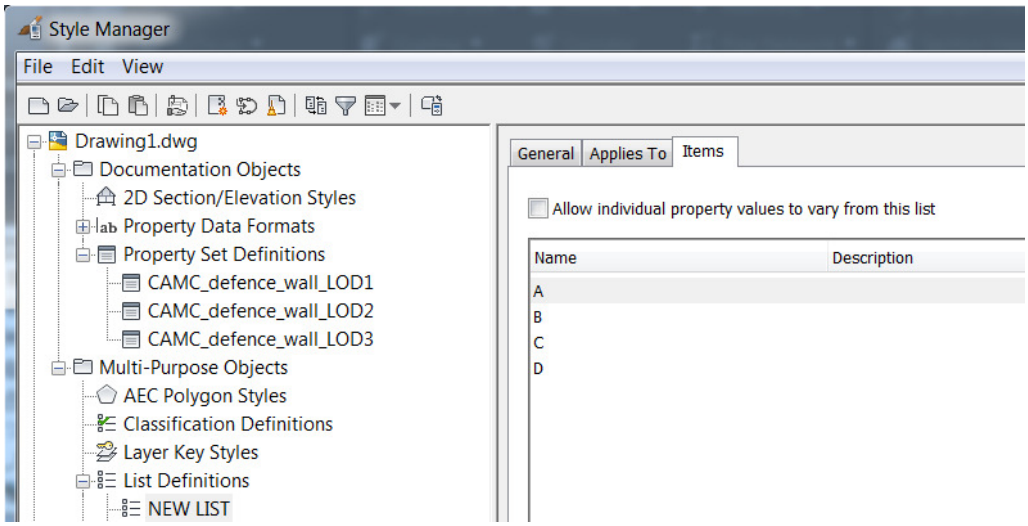


Text – Text entered by users such as design comments.
List – Variable to be selected based on a list of values such a pipe trench type.
True or False – Binary variable such as Inspected in the last 12 months.
Integer – Count such as number of inlets

All manual set definitions can have a default value set.

Once created they can't seem to be renamed so think carefully!

To use the list type of Manual set definition you first need to create a list definition in Multi-Purpose Objects > List Definitions



LIST DEFINITION – SIMPLE LIST

This shows a simple list, but any list of variables can be created to add structure to the property set.

The check box above the list allows you to fix the selection to the list or to allow it to vary.

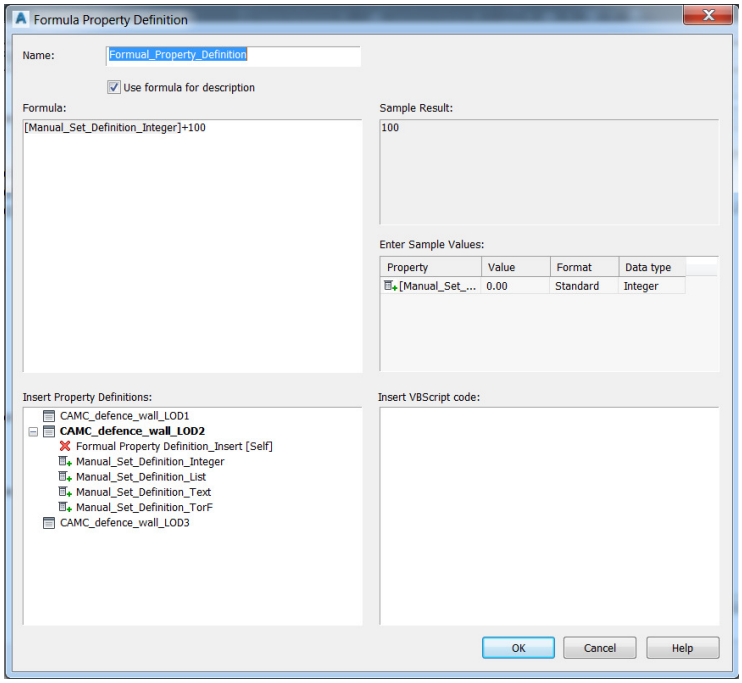
For a lot of asset information requirements list are very useful, by creating a list once in the style manager all users will get a consistent drop down when entering asset information resulting in more efficient population of data and more consistent outputs.

Add Formula Property Set Definition

The third button, Add formula property set can be used to add more intelligence to property data sets.

The add formula property set definition allow calculations using other property datasets.

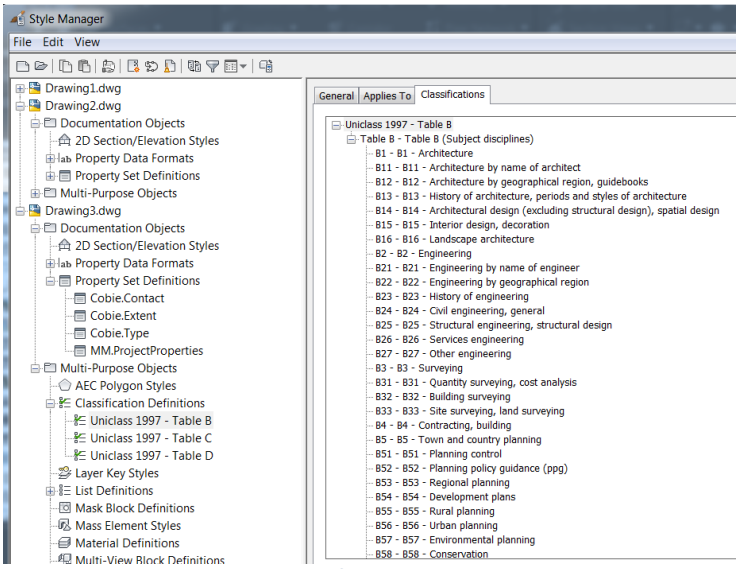
In addition VBScript can also be used to return values



SIMPLE FORMULA

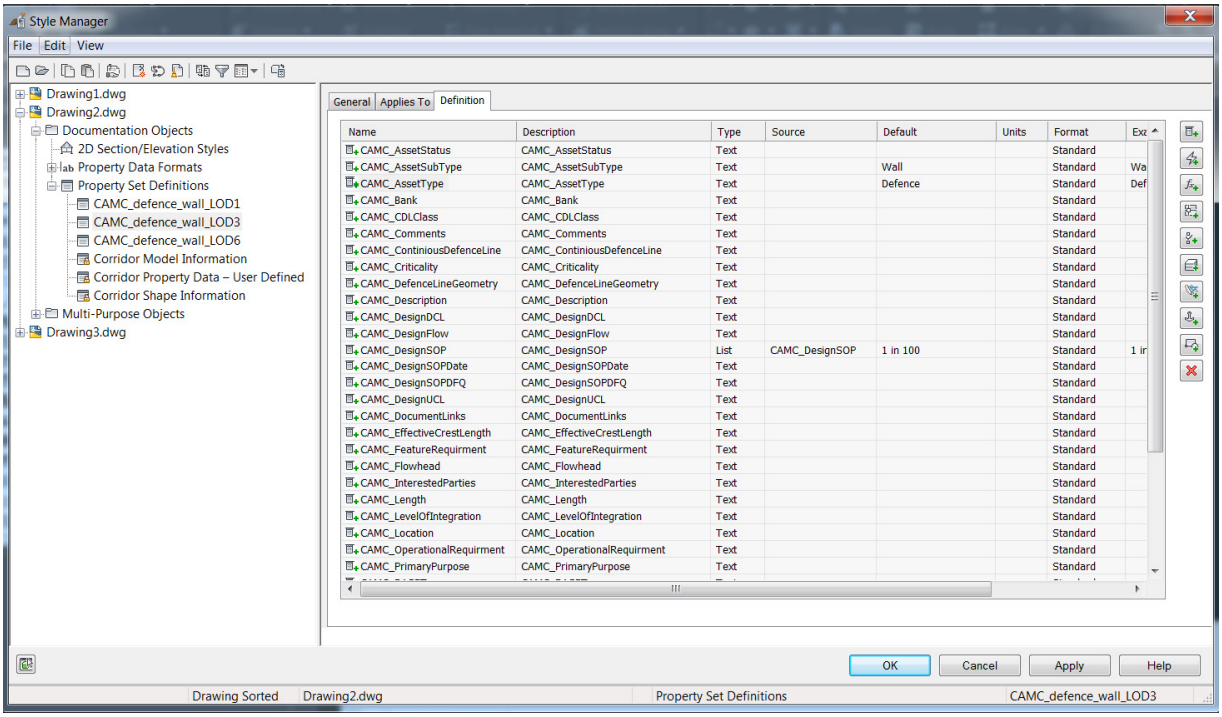
Add Classification Property Set Definition

The fifth button, add Classification property set definition can be used to apply classification definitions to objects.



UNICLASS CLASSIFICATIONS.

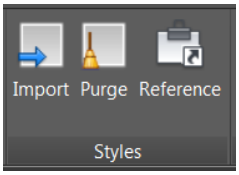
Once you have created a full set of property definitions that match the information requirements for the asset type you are designing save the file as a drawing template (.dwt)



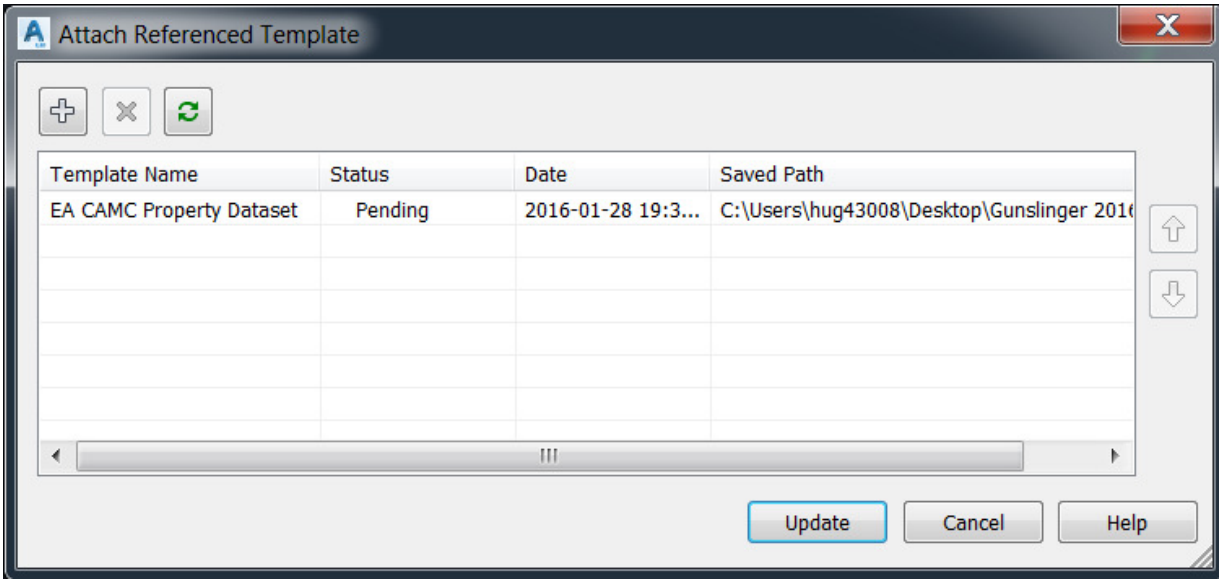
EXAMPLE OF THE COMPLETED PROPERTY SET DEFINITION FOR THE EA CAMC FLOOD DEFENSE WALL

Step 4 – Reference Styles (New to Civil 3D 2017)

Another new feature added to Civil 3D 2017 is the ability to reference style templates. An unexpected benefit of this additional feature is that it presents a very good way to manage property sets for a variety of asset types and asset data.



MANAGE > STYLE REFERENCE

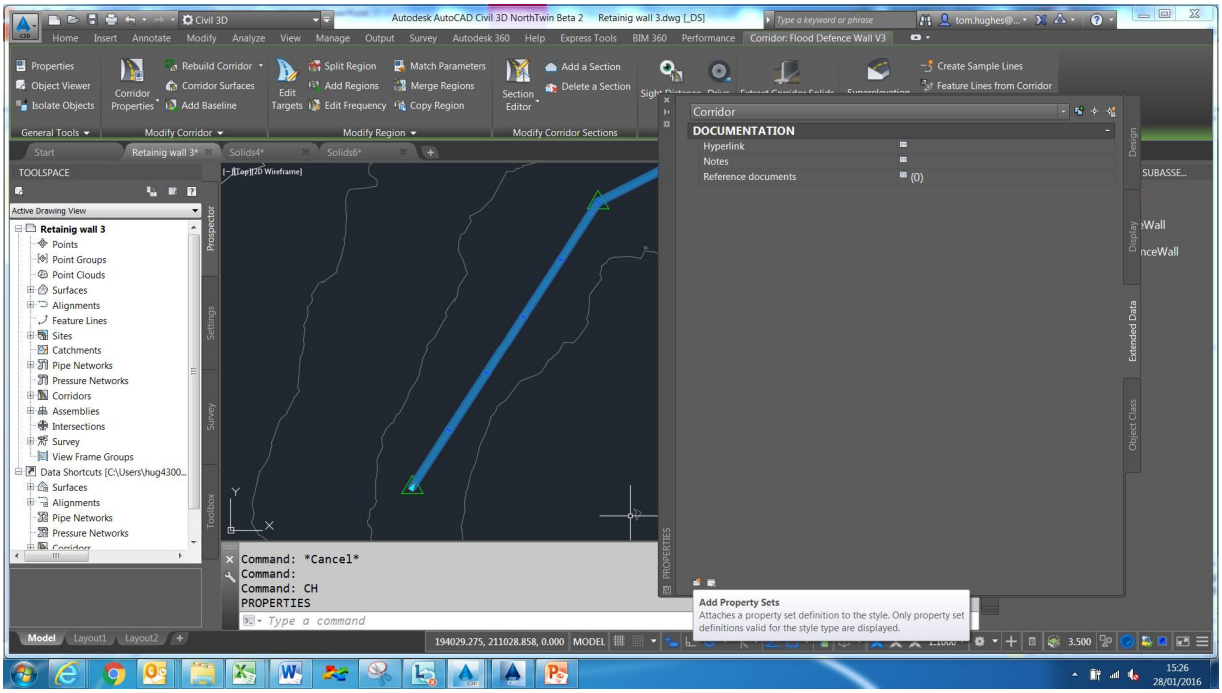


ATTACH REFERENCED TEMPLATE

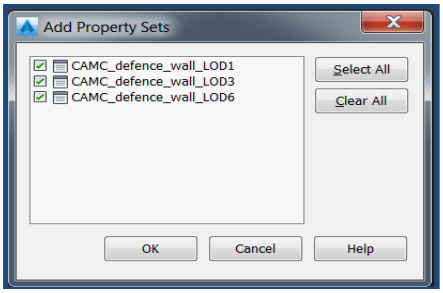
This means that a template drawing containing asset data requirements for each asset type can be set up. As model are created they can reference the relevant style templates as required to have a consistent data structure right across the project or your whole organization.

Step 5 – Add property data sets to your Civil 3D objects (New to Civil 3D 2017)

Once you have created your Civil 3D objects navigate to the extended data tab of the properties pallet. You will notice that there is now a small icon in the bottom left of the pallet to add property sets. Once added to an object the property data will appear in the extended data tab and rich asset specific information can be added to Civil 3D objects.

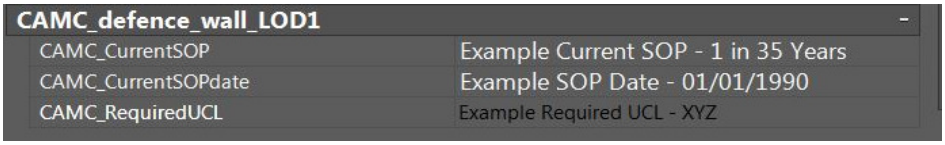


PROPERTIES > EXTENDED DATA

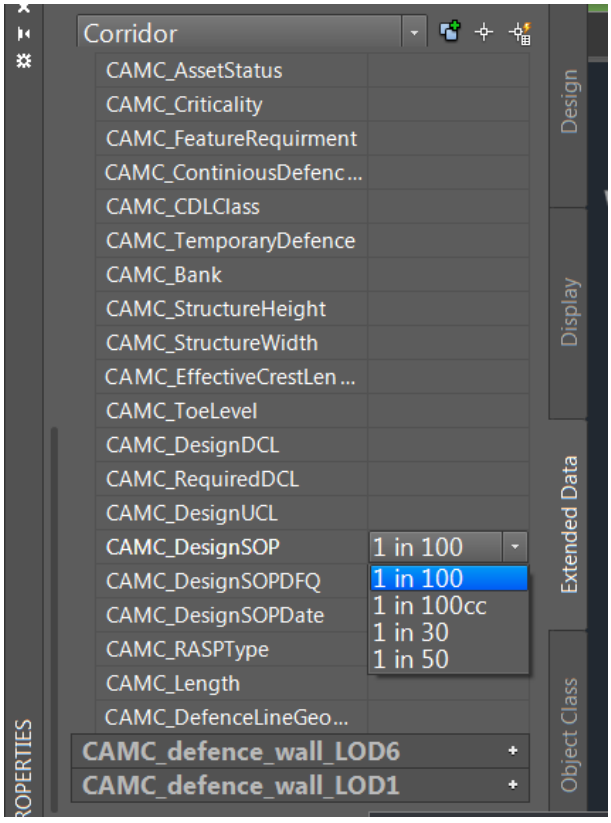


ADD PROPERTY SETS

PROPERTY SETS NOW PART OF EXTENDED DATA



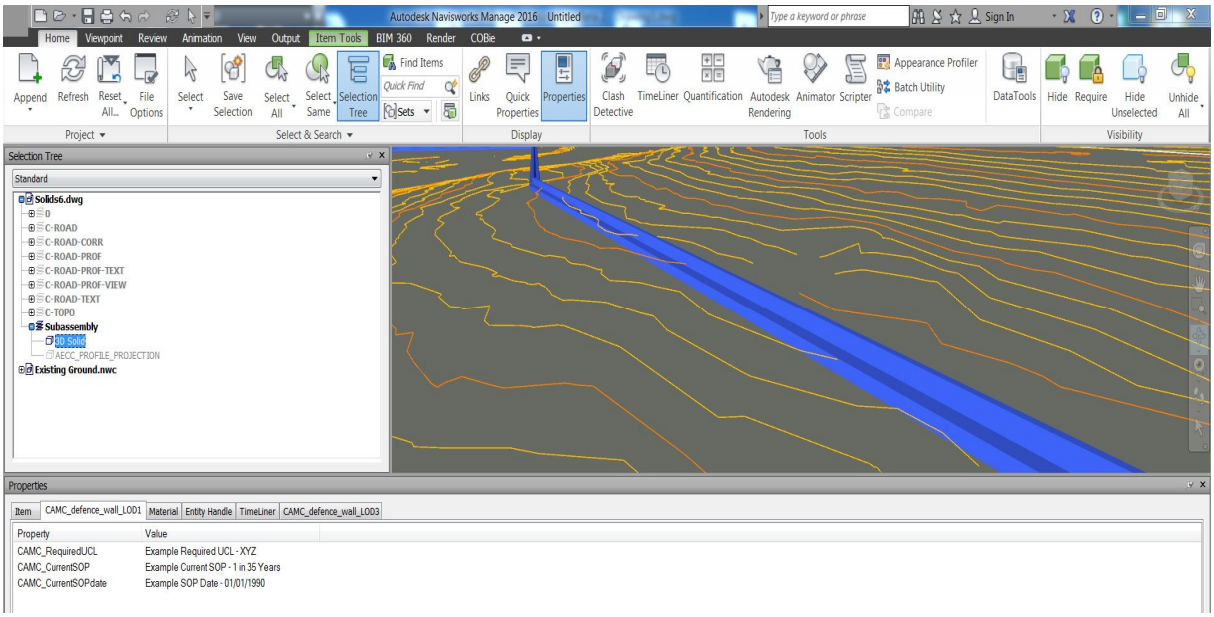
ASSET SPECIFIC PROPERTY DATA CAN NOW BE ADDED TO CIVIL 3D OBJECT



LIST TYPE PROPERTY

Viewing Asset Information Down Stream

Having added asset information to a Civil 3D model it is important to know that this information can be shared and viewed using Navisworks. Extended property data is accessible by selecting the object and viewing the properties tab.



VIEWING OBJECT PROPERTIES IN NAVISWORKS

Each of the property sets that were defined in the template and then added to the objects extended data are now a unique tab within the object properties making it easy to view the asset information in a structured way.

COBie for Navisworks Tool

The COBie for Navisworks tool is a data exporter that is available for the following versions of Navisworks

- Manage 2016 & Manage 2017
- Simulate 2016 & Simulate 2017

The latest version of the COBie for Navisworks tool is available here, along with some videos explaining key workflows.

http://beyonddesign.typepad.com/posts/2016/08/cobie-for-navisworks-tool-now-updated.html

Configuring the COBie for Navisworks Tool

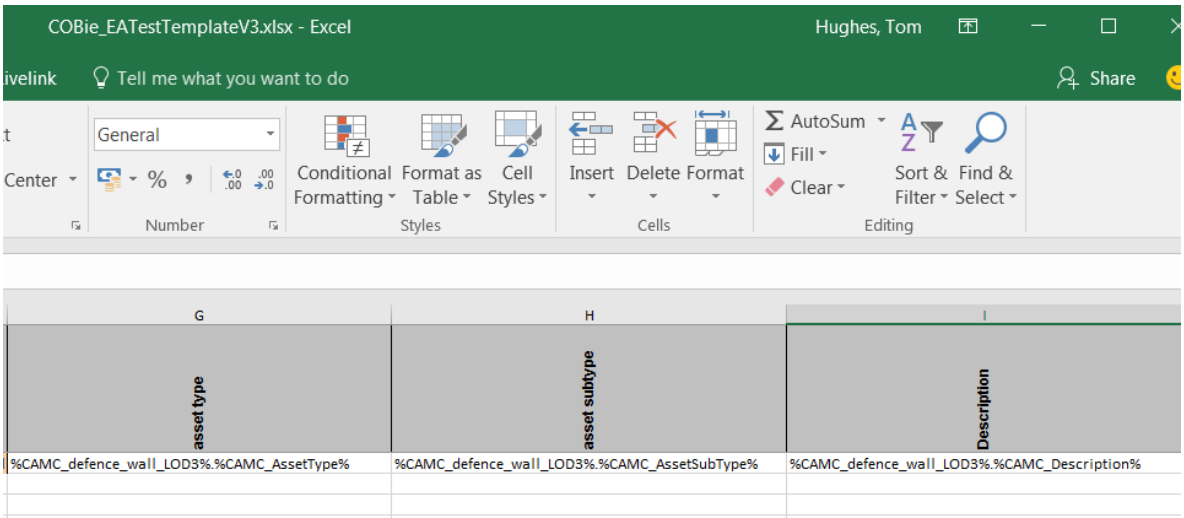
'Out of the Box' the COBie for Navisworks tool comes with a template for extracting building asset information in COBie format.

For an infrastructure project this isn't very useful but it gives us the opportunity to see how the COBie for Navisworks tool works.

The data extraction format of the COBie tool is;

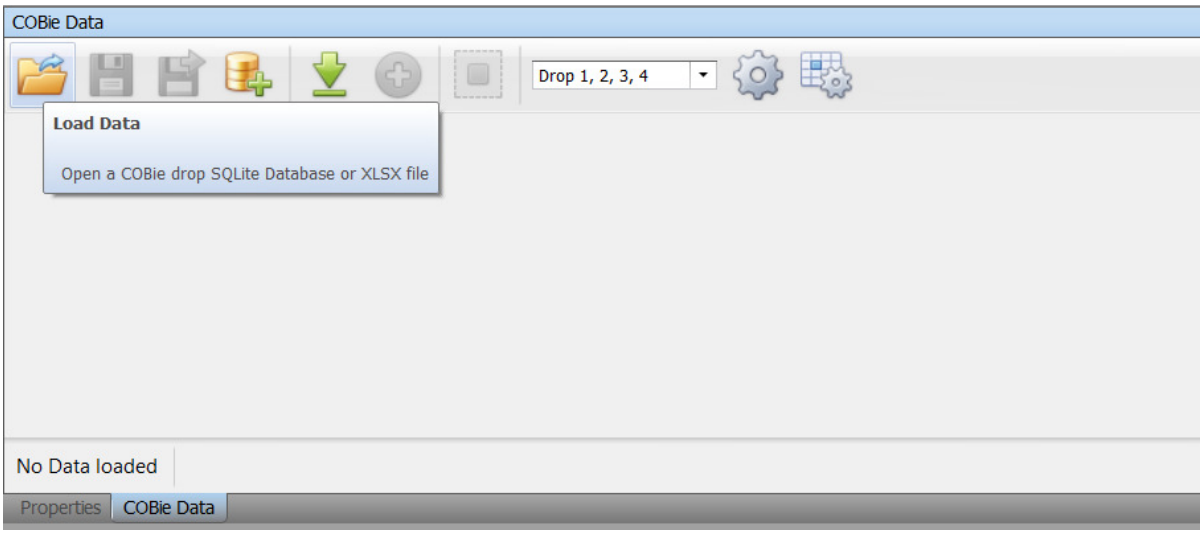
%PropertySetDefintion%.%PropertyName%

Because we have defined the property sets as part of the process for adding asset information we can use the same definitions to extract the data from the models in Navisworks.

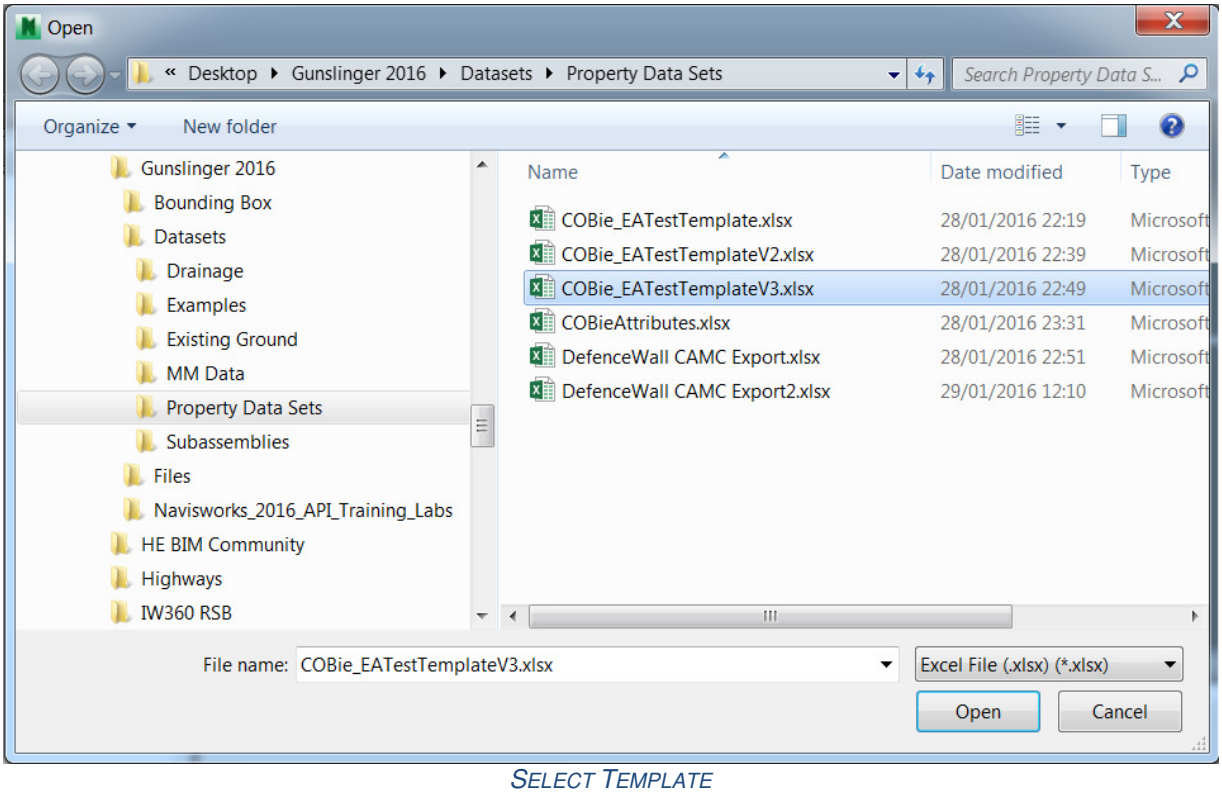


CONFIGURING THE COBIE TOOL FOR CAMC ASSET DATA

Once the template is configured it can be loaded into the Navisworks Tool using the Load Data button.

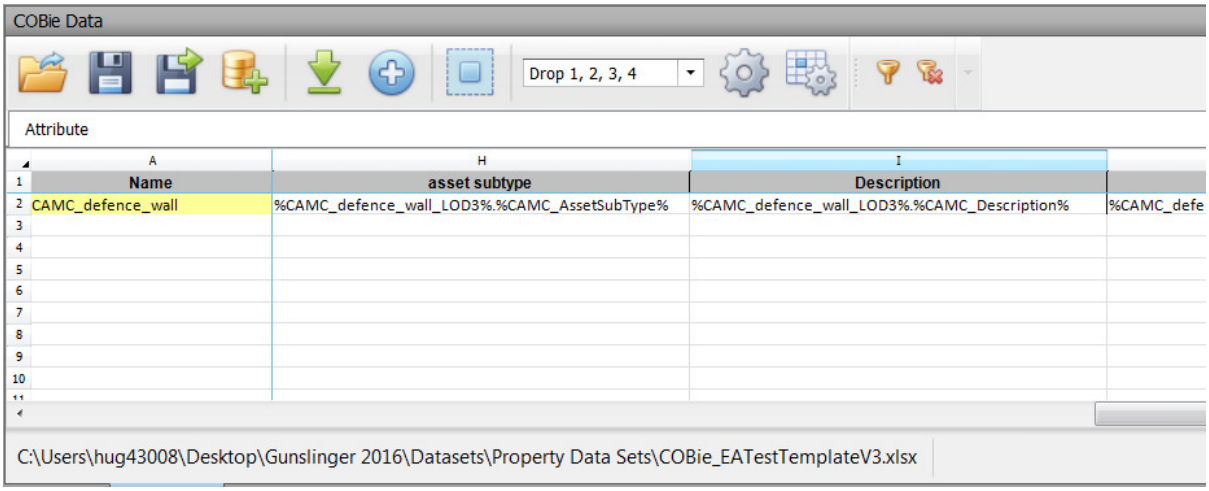


LOAD DATA

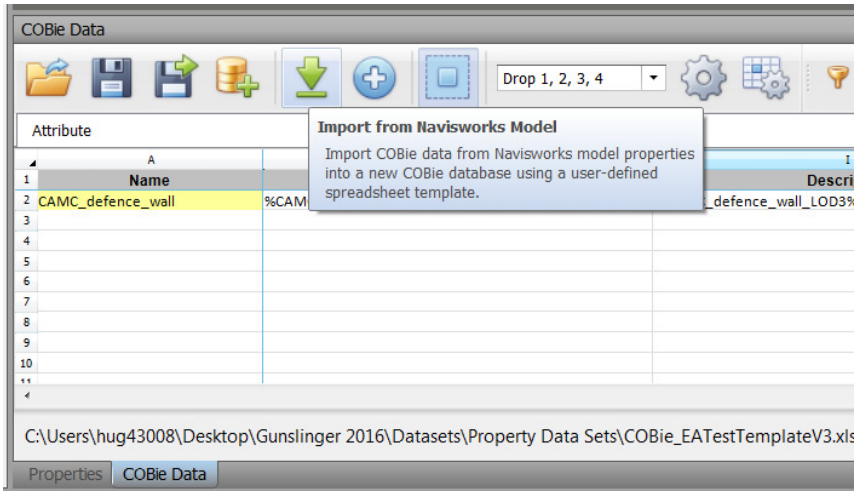


SELECT TEMPLATE

The COBie tool will now be configured to extract your client specific asset data

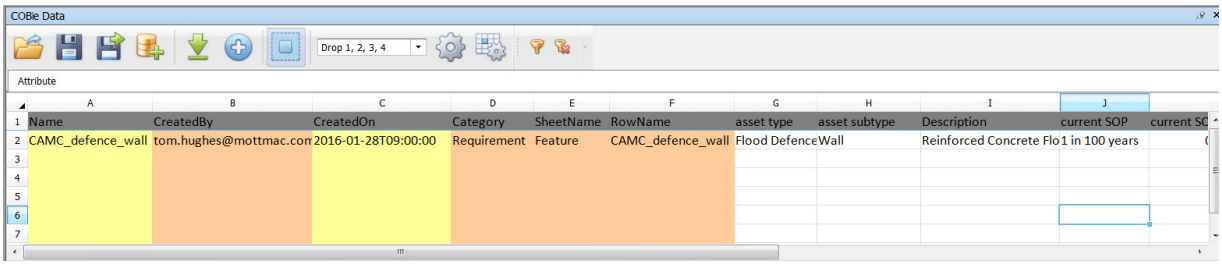


CAMC ATTRIBUTES



SELECT THE IMPORT FROM NAVISWORKS MODEL

Select the template again and the COBie tool will extract the property data from the objects in the Navisworks model.



ASSET INFORMATION EXTRACTED FROM THE CIVIL 3D PROPERTY DATA

This data can now be saved as an Excel workbook or a SQLite database for handover.

As COBie is displayed as a multi sheet workbook in excel the COBie tool supports multiple tabs making it possible to set a tab up for each of the asset types in your Asset Information Requirements.

Class Recap

My objective of this class was to change perspectives about 'Asset Information' for infrastructure projects.

I hope that this class has increased your understanding of what asset information is, why it is valuable, and how Civil 3D and Navisworks can be used to create it.

The learning objectives for the class were;

Add rich data to an infrastructure model

We looked at how the ability to create property set definitions and then add them to Civil 3D objects opens up huge opportunities to add much more asset data to your models.

Configure the Navisworks COBie Extension based on client asset information requirements

We looked at how the user-defined spreadsheet template can be set-up to match the client asset information requirement making the COBie exporter tool much more versatile than you may think.

Set-up and manage property set definitions

We looked at how property set definitions can be set-up to match client asset information requirements and data drops.

We saw how different types of property set definitions can be used to structure the asset data enter and add intelligence.

By setting up property set definitions in a referenced template we showed how these can be managed and applied to multiple design files.

Use several new product features in AutoCAD Civil 3D 2017

Referencing Style Templates and Adding property data sets to Civil 3D object are new feature in Civil 3D 2017.

I hope that this class has been useful to you and that you will find opportunities to use these examples on your projects to add more value to the models you produce.

If you have any comment and would like to contact me my email address is

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