Not Just a Pipe Dream: AutoCAD® Civil 3D® Pipe Networks

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CI4351-P Not Just a Pipe Dream: AutoCAD® Civil 3D® Pipe Networks

This class is designed to give experienced AutoCAD Civil 3D users the "ins and outs" of Civil 3D pipe networks, and build upon their existing knowledge of the feature. The class will also cover rules, customization, import and export (including the new SHP functionality), and some basic troubleshooting.

Learning Objectives
At the end of this class, you will be able to:
- Create Pipe Networks using all available methods
- Create Customizations for Pipes and Structures
- Describe how and when rules work
- Understand Import and Export Settings
- Perform Basic Troubleshooting

About the Speaker
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Creating Pipe Networks

Although this subject may be elementary, there are a few different ways to accomplish this in the 2012 release, including a brand new method for 2012. From the tried and true “picks & clicks” approach using the Pipe Network Creation Tools, and using existing geometry with the Create Pipe Network from Object, to the new option to import from a SHP file.

We all know the ways to create pipe networks that have been available for the past releases, as a refresher we will review how they were done in the past to how they can be accomplished today.

Pipe Network Creation Tools
This option is best used when beginning a new design without any existing geometry already drawn. You will be able to select an alignment and surface, and more importantly any rules you have specified to apply to your network will be applied as drawn.

Create Pipe Network from Object
This option may be especially helpful if you already have the existing geometry, or are performing an as-built of existing conditions. The supported objects that you can create a pipe network from are as follows:

**AutoCAD Objects:**
- 2D Polyline
- 3D Polyline
- Line
- Arc
- Spline

**Civil Objects:**
- Alignment
- Feature Line

This can be accessed from the Pipe Network dropdown in the Create Design Panel of the Home tab in the Ribbon, or by command line CreateNetworkFromObject. After the command is run, simply select the object, and the command line will prompt asking if flow direction is OK or you would like to Reverse. Upon making your choice and hitting Enter you will then be greeted with the Create Pipe Network from Object dialog. There is some important information and choices to make here, so be sure to review them all.

Especially important is the Vertex Elevation reference if you are using existing 3D geometry for something like an as-built. This will
control where the pipes will be placed in relation to the object you are creating the pipe network from. So if for example you sent your field crew out and they shot all top of pipe, then you could specify Outside Top and the pipes would be placed at the correct elevations.

**Interference Checking**

After your pipes are created you can run what are called Interference Checks on your pipes and structures. These can be accessed either by the Ribbon (Analyze tab>Design Panel>Interference Check) or directly through Prospector under the Pipe Networks tree. By running this command you will be able to see if there are any conflicts between one or more pipe networks. You will be notified in model space where the interference occurs so that you can easily identify and address the issue.

Also within Interference Checks is the ability to apply a 3D Proximity Check. Proximity Checks help identify potential conflicts when two parts are too close together in the 3D space. There are two options to choose from:

**Use Distance:** When choosing this option Civil 3D will determine if there is any part within the specified distance. For example the distance is set to 5.0’ an interference is created for any part that is less than 5.0’ away from another part.

**Use Scale Factor:** With this option, you choose a scale factor, and Civil 3D determines the outer limits of the part and multiplies it by that scale factor. For example you have a 48” Cylindrical structure, and a scale factor of 3. All parts within 144” or 12’ will be “flagged” as an interference.

These checks will populate under the Interference Checks tree in Prospector and can be rerun once edits have been made to the network to ensure the violation still is not occurring. Once the Check has been addressed, it will no longer exist in the Prospector tree.
Create Pipe Network from GIS (SHP) data
We recently saw the functionality to import SHP files directly into Civil 3D be integrated into the 2012 release. This allows for a simplified import process from something like a municipal sewer or water into a Civil 3D pipe network ready for design. Although the ability to “round trip” the data from GIS to Civil 3D, make design changes, then send back to GIS may not have an elegant solution yet, it can be done with the use of Storm and Sanitary Analysis.

Bringing GIS (SHP) data into Civil 3D
Introduced in the 2012 release of Civil 3D is the ability to directly import a SHP file into Civil 3D and create a pipe network out of the data. Previously to do this you would have needed to do a lot of handle drafting and editing of invert elevations after the fact to accomplish this.

First let’s begin with the data. As with anything, the end result is only as good as what you put in. If the original GIS data has the correct object data associated with it, (inverts, pipe size, materials, etc.) you are going to get a better end result. Additionally you will also need to take into consideration the amount of vertices that these pipe lines have in them. If the pipes have many vertices between actual pipe start and end, Civil 3D will place a null structure at each one of these vertices. This may be acceptable if the pipe really does end there, but edits may need to be made prior to import as well as after the fact.
If the data has excessive amounts of vertices, you can easily edit these with a few different options. Beginning with the new AutoCAD functions in which you can hover over the vertex and it gives an option to remove the vertex. Next is the most efficient option, using the Map Cleanup functions of the MAPCLEAN command. The Simplify Objects option will make quick work of the extra vertices. Finally you have the option of using the WEED command, which you may recall using with feature lines, but it works with polylines as well.

These options make quick and easy work of the vertexes and will preserve the proper inverts per the original object data. If these are really unnecessary vertexes, then removing them will not alter the slope or invert object data attached to the objects, everything will remain intact and correctly import. Please note that to edit this data in one of the above options; it will need to be imported via MAPIMPORT, cleaned up, and then MAPEXPORT back to SHP.

As shown in the initial screen shot, the connections have been made for various other features for these city blocks. Also added through the Map Task Pane is the sewer main and manholes for reference. Beginning from the IMPORTGISDATA command or from the Ribbon INSERT tab>IMPORT pull down you can initialize the command. This launches the Import GIS Data Wizard/dialog. Much like the CREATESURFACEFROMGISDATA command or connecting to the data through Map Task Pane you will be asked to connect to either a single SHP or a folder containing SHP files. This is where you need to start thinking about what edits you will be making after the import.
If the folder is selected that contains both the pipes and structures SHP file, the structure will be created at every pipe ending in addition to the actual structure being added. So in most instances there will be duplicate and sometimes more (depending on the amount of pipes coming into the structure) structures created. This could cause quite the headache to determine the correct structure, created from the actual SHP data, and the one that was put there by Civil 3D on account of the pipe start or end.

This can be addressed with one of two options. First, if the pipe and structure SHP files are selected and imported separately, then you can address these duplicate structures prior to importing the structure SHP file. Upon importing the pipe SHP, the pipe start and end structures will be automatically created. These can be deleted all at once by selecting the network>EDIT PIPE NETWORK then selecting the Pipe Network Vistas (Panorama) option. In Panorama simply select the Structures tab, then select all of the structures in the drawing, right click>DELETE. This will leave the import with nothing but pipes, and no structures.

Moving on to import the Structures SHP, it can now be done without the pipes included so this will strictly import the structures only. When the structures are in the drawing, you will notice that you cannot import into the same network. The Civil 3D command MERGEPIPENetworks will make quick work of this issue; and after merging you will be left with a single pipe network containing both pipes and structures with no duplicates.

*IMPORTANT NOTE: If imported separately these pipes and structures will not be connected entities. The connections will need to be made manually if this is what is desired.

The second option would be to select the folder that contains both the structure and pipe SHP files. As mentioned, the “good” structures and the duplicate null structures will be imported into the drawing. A benefit of using this method is that the pipes and “good” structures will be automatically connected, and not require the extra steps of merging the two networks and connecting the pipes and structures together.

To address these null structures, you have the option of setting the null structure style to a “no display” so they will not be visible in the drawing or design, or simply select and delete them from the Pipe Network Vistas (Panorama) much like the single file import method described above. This method will require some shift selecting of the null structures in order to preserve the “good” structures created directly from
the SHP data. After the null structures have all been removed from the network (or hidden) the end result will be a complete pipe network with connected parts, ready for the design.

After the connection has been established, the ability to move throughout the wizard has been enabled. Moving on to the Object Options, the network name, parts list, surface, alignment, and labels can be selected.

*IMPORTANT NOTE: Regarding the Parts List selection, you are going to want to ensure you have parts created and/or modified to properly represent what information is contained in the SHP file. For example the SHP contains Ductile Iron pipes. You are going to want to ensure you have Ductile Iron pipes added to the parts list to ensure the parts will match up.

In the Schema and Coordinates section, the ability to select which coordinate system and schema is used, per the Civil 3D HELP:

- Schema: Specifies a GIS schema, a metadata file that contains descriptions of data types found in a datastore.
- Feature Class: Specifies the GIS feature class.
- Coordinate System: Specifies the coordinate system for each feature class.
- Restore the Original Coordinate System: Click to restore the feature class coordinate system to the setting specified in the SHP file.
- Drawing Coordinate System: Displays the coordinate zone assigned to the current drawing.

Now onto the Data Mapping of both the pipes and the structures (which arguably could be the most important step of the process). Here the object data associated with the SHP objects is matched up with parameters from the Civil 3D parts. Depending on the original SHP data, you may have a lot of available Imported Data Fields or there may only be a few available. The most important ones would obviously be the field that actually will be drawing the pipe networks. Fields like inverts, materials, slope, inner diameter, rim elevation, sump elevation, etc. will be critical to the successful import of this data.
Beginning with selecting the Imported Pipe Feature Class, then the Civil 3D Pipe Shape. The pipe shape selected here will correspond with the parts lists selected in the Object Options. Now the properties from the object data must be matched up with the part properties from the Civil 3D Parts List.

At this point it is helpful to connect to the same SHP files you will be importing so the object data can be viewed through either the Properties palette or the Map Data Table as this will ease the process of mapping the data. This will only need to be done once, since the mapping data can be saved and loaded for later use as a XML file.

*IMPORTANT NOTE: If you are going to be saving your Data Mapping for later use, you must save an XML file for both pipes and structures. They will not be combined into one XML file to be loaded at a later date. These files should also be named appropriately as to not cause any confusion.

The same process will need to be followed for both the pipes and structures. However along with matching the properties, the units will also have to be set as well. This is an important step in the process as if this unit is not set here than the Civil 3D will take the first pipe size in the specified parts list and assign that to all the parts.

After all attributes have been assigned to the appropriate object data, move on to the Query Options. If you are prompted by the “No Shape Attributes Assigned” dialog, this may be due to the fact that a necessary attribute was not matched up and you may need to go back and make the correction. Moving through this dialog; next is the Query Options. The Query Options add the ability to filter the imported GIS data to a specified area in the current drawing. The options are Import All, Basic Query, and Advanced Query. The Import All option is exactly what it implies (and will be used in this example), however the Basic Query provides a few options to filter the exact data to import, by using either a boundary type or selection type. Advanced Query definition dialog is used to create a custom query from mathematical expressions.

Lastly is the Clean Up option, which will attempt to clean up the SHP data upon final import, and is best described by the Civil 3D HELP:
• Snap Pipe and Structure Tolerance: Specifies the tolerance value for snapping the end of a disconnected pipe to the nearest structure. If the end point of a disconnected pipe is less than or equal to the tolerance distance from a structure, the pipe will be connected to the structure automatically.
• Discard Unlinked Pipes: Specifies that disconnected pipes are not imported.
• Discard Unlinked Structures: Specifies that disconnected structures are not imported.

Upon making all of these selections, the last step is to click FINISH to import the pipes. A status dialog will display the progress of the command, then the pipes will display per the options selected in the wizard. After the pipes have been imported a quick view of the properties palette reveals that the new Civil 3D pipe network has been imported successfully and correctly.

Round Trip Pipe Data back to SHP
As mentioned above, there is not a completely elegant solution to “round trip” the pipe data back to SHP format however it can be accomplished with SSA and the ability to export pipe data to GIS.

Upon initiating the EDITINSSA command Civil 3D will export the pipe network to SSA for further analysis. When viewed in SSA you will see that extra OUTFALL-OFFSITE lines are created. The data is coming in correctly into SSA, however the extra OUTFALL-OFFSITE lines that are shown are due to the fact that Civil 3D is creating an STM file and exporting that to SSA. There is a slight difference to the way Hydraflow handles inlets and the way SSA handles inlets. In Hydraflow for an inlet you would need to specify the bypass. However SSA does not consider any bypass for an inlet, so to match the STM it creates an open channel connected to the inlet which drains to an outfall. That is those extra lines you see on the exported data. This information can be reviewed on page 511 of the SSA User’s Guide:
Hydraflow Bypass Targets with a value of OFFSITE will be imported as an Autodesk Storm and Sanitary Analysis outfall with an element ID containing the prefix OFFSITE-. Each outfall will be drawn at an offset to its connecting inlet.

These extra lines can easily be deleted, or LandXML can be used to bring the pipes to SSA.

Given this information, LandXML may be the more efficient method as the extra lines created from the STM import will not be present. However, given the fact that the data has been imported and exported multiple times thus far the pipe data will not be left with the same robust object data found in the original SHP file. In fact, only the critical data will make it through the round trip. Pipes will retain the invert elevations as well as the pipe size.

Customizing Pipes and Structures
There are many options to customize your pipes and structure without ever having to actually create a custom part within Part Builder. From creating adding new part sizes and custom parameters, to adding a new material, there are some easy changes to make in order to get the desired effect.

Custom Part Sizes
Sometimes in the course of a design you will realize that you may need an extra set of part sizes to fully comply with local regulations and/ manufacturers. Although this is better done prior to the design and kept in a “master” catalog, it can be quickly and easily modified to include the desired sizes.

For example the need for an existing 12” Concrete Pipe that your field crew located when shooting existing conditions at a new project. Adding this size begins by launching Part Builder from the HOME tab>CREATE DESIGN panel dropdown>PART BUILDER.
Select the desired Part Family from the Getting Started – Catalog dialog and select Modify Part Sizes. Once Part Builder has been loaded, Click on Size Parameters, right click, and then Edit Values.

Once in the Edit Part Sizes dialog, select an existing size which will then activate the “new” button. The new button will now be active and you can select it. Upon clicking the new button, a new size will appear at the bottom of the list. This new item can be edited by clicking in the field, and editing it to the desired content, in this case 12”.

Once all the necessary sizes have been added it is time to validate and save the changes you have made. This is done by clicking OK out of all the dialogs, going back to the initial Part Builder side bar. Clicking the little “traffic light” will validate the part family, and finishing it off by clicking on the Save button all the way to the left.

Now that the changes have been properly added to each size, one more step is required to actually use the new sizes in your drawing and templates. Launch the drawing (or template) and type the command PARTCATALOGREGEN, the <P> and <S> for pipes and structures respectively. This command will refresh the drawing with the latest information available in the Part Catalog.

Custom Materials
In this section we will discuss how to add a custom value to your existing material parameter of your existing parts.

As with a lot of aspects within your parts catalog, these values are populated and are dependent on an XML file. Specifically the AeccSharedPropertyLists.xml typically found here:

C:\ProgramData\Autodesk\C3D 2012\enu\Pipes Catalog\US Imperial Pipes
Not only can you add new values, but you can change existing ones. For example Ductile Iron pipe is available in the stock configuration, but requirements state that this pipe be labeled as DIP. Simply changing the value in this field will provide the desired results.

First we will want to open the AeccSharedPropertyLists.xml in whatever program you are most comfortable editing XML files in. In this example I will be using Notepad.

You will see that this is a fairly simple XML file and the area you will want to be concentrating on is under

```xml
<ColumnConstList desc="Material" dataType="string" unit="" name="Material" id="CCL1" visible="1" context="Material_Type" index="0">
  <Item id="i1">Reinforced Concrete</Item>
  <Item id="i2">Corrugated Steel</Item>
  <Item id="i3">ABS Plastic</Item>
  <Item id="i4">Ductile Iron</Item>
  <Item id="i5">PVC</Item>
</ColumnConstList>
</LandPart>
```

In a stock configuration you will see <Item id="i1">MATERIAL</Item>, proceeding down the list with “i2”, “i3”, “i4”, etc. In order to add a new value just plug in the desired value, for example <Item id="i6">Clay</Item>. Add as many as you like, then save the changes you have made. Upon returning to Civil 3D you will now see these materials available to select and use, no need for PARTCATALOGREGEN.

Much like adding materials to pipes you can also do the same to structures, and go one step further and Frame, Cover, and Grate. This XML file, just like the one for the pipes is located in

```plaintext
C:\ProgramData\Autodesk\C3D 2012\enu\Pipes Catalog\US Imperial Structures
```

In a stock configuration the only values under Frame, Cover, and Grate are <Item id="i0">Standard</Item>. Additionally the only values under Material is <Item id="i0">Reinforced Concrete</Item>. I supposed there are not as many reasons to change these values here, but they are available if you need to. The process is basically the same; add additional entries under each heading with an incremental Item id, “i1”, “i2”, “i3”, etc. Add as many as you like, then save the changes you have made.
Optional Parameters
Optional Parameters are available in addition to the standard parameters that exist for pipes and structures. They can add further definition to a part and can be used in various areas of the drawing after they have been added to the part, mainly labeling and in tables.

Same as adding the custom materials listed in the above section, we will start by editing the AeccPartParamCfg.xml file which is typically found in this location:

C:\ProgramData\Autodesk\C3D 2012\enu\Pipes Catalog\Aecc Shared Content

Again you can open and edit this XML file in whichever program you prefer, but in this case I will be using Notepad to edit.

For this exercise, we are going to be adding a new String data type and call it NHDOT. Under the section <AeccParamDeclaration> is where we will start the process. Simply copy (CTRL+C) a line that works and modify accordingly. Here is an example that has been copied and modified:

```xml
<AeccDfParameter name="NHDOT" desc="NHDOT" context="NHDOT" index="0" datatype="String" usage="String_General" managelist="True" unit="" visible="True" internal="True"/>
```

After you have successfully edited and created this new line in the XML file, we move on down to the <AeccParamUsage> section and place the counterpart for our new optional property. Our example will look like this:
Once this has been added for each of the new custom parameters you can save and close out the XML file.

*A cool little side note if you are interested. Ever wonder what some of the “usage” types in the above XML line? Here is a small list of what some of these translate to:

- Double_SmallDistance = Inches
- Double_Distance = Feet
- Double_General = No units applied
- Bool_General = True/False

By examining the way Part Builder uses these, just have a look at the AeccPartParamCfg.xml and see how these correspond to the parameters.

After the XML file has been properly edited, it can now be added to the intended Part Family. This is done from within Part Builder, found by clicking HOME tab>CREATE DESIGN panel dropdown>Part Builder. Select the desired Part Family from the Getting Started – Catalog dialog and select Modify Part Sizes. Once the drawing and Part Builder has been loaded Click on Size Parameters, right click, then Add.

Clicking “Add” will present two dialogs, the Edit Part Sizes, followed by the New Parameter dialog. In the New Parameter Dialog scroll down to find the newly created “NHDOT” parameter, select it and click OK. The new parameter is now added to the configuration of the part. Once it has been added you can now determine what Data Storage type you would like to use. For example set it to List, and from the Values dropdown, you can add the typical values that your users will populate these parameters with when adding them to the parts list.

Once all the necessary edits have been made it is time to validate and save the changes you have made. This is done by clicking OK out of all the dialogs, going back to the initial Part Builder side bar. Clicking the little “traffic light” will validate the part family, and finishing it off by clicking on the Save button all the way to the left.

Now that the desired parameters have been added to all the necessary parts, what can you do with them? Well, these parameters can be added to labels and tables to enrich the amount of data that can be shown in your plans and meet any necessary requirements.
These parameters, such as the NHDOT example, will now populate in the Text Component Editor of the pipe/structure labels. Once added within the label style, the will automatically populate the selection from the List values added from within Part Builder.

As you can see from the final result, the labels can be as robust as you need them to be. Adding anything from stock numbers to manufacturer information, that may be necessary to display on your final designs.

Just as these parameters will show up in the Text Component Editor of the label styles, they will also be able to be used when placing a table.

What can Rules do for you?
The usage of pipe and structure rules can drastically cut down on the time it takes to design a network. Using just one or a combination of few of them will allow you to draw the lines, while Civil 3D calculates anything from inverts, ground cover, to how connections are made.

Pipe Rules
There are 5 types of pipe rules in the 2012 release of Civil 3D.

Set Pipe End Location: This rule is new to the 2012 release, and one of my personal favorites. This rule allows you to set the beginning and end location of your pipes based on the following options:

- Structure Center
- Structure Inner Wall
- Structure Outer Wall
It will also allow you to specify an offset if local regulations require it. The parameters are as follows:

**End Location:** Specifies where the pipe will end based on the structure walls and optional offset.

**Start Location:** Specifies where the pipe will begin based on the structure walls and optional offset.

**End Offset:** Enter a specific distance to determine the desired offset in addition to the specified End Location.

**Start Offset:** Enter a specific distance to determine the desired offset in addition to the specified Start Location.

This rule is especially helpful in labeling your invert elevations. In the past pipes extended all the way to the center of the structure, now they can be ended exactly where you want them to produce the correct labels.
Cover And Slope: Perhaps the most popular rule for gravity systems, “a rule to rule them all” if you will, is the cover and slope rule. This rule ensures that the minimum cover and slope is met at all times, or you will be warned accordingly. The rule will do its best to “fit” everything according to the parameters you have set. *The first pipe in the network has the highest priority. The parameters are as follows (best explained by the Civil 3D HELP):

Maximum Cover: Specifies the maximum cover of soil over the length of the pipe, based on the surface being referenced by that pipe. If the maximum cover is exceeded, a rule violation occurs. Note that this parameter provides validation only; it does not alter (move or resize) the part in the drawing in any way. It simply produces a rule violation on the part if the specified value is exceeded.

Maximum Slope: Specifies the maximum slope of the pipe, expressed in percent. If the pipe slope is greater than the maximum, a rule violation occurs for that object.

Minimum Cover: Specifies the minimum cover of soil over the pipe, based on the surface being referenced by that pipe. During layout, a pipe will be created that attempts to maintain the minimum cover. This is also used to determine the initial elevations of the pipe. If the pipe is edited so that its cover is less than the minimum cover value, a rule violation occurs for that object.

Minimum Slope: Specifies the minimum slope of the pipe, expressed in percent. During layout, a pipe will be created according to its minimum slope rule value. If the pipe is edited so that its slope is less than the minimum, you can still edit the pipe as desired, breaking the minimum slope rule, but a rule violation occurs for that object.

Now I know everyone can read the Help in Civil 3D on their own time, but the real question is how and in what order does this work?

1. Upstream invert elevation is set based on the cover at the structure.
2. Downstream invert elevation is set based on cover at the structure.
3. Slope is checked:
   • Minimum slope violation: upstream invert elevation is held>minimum slope applied
   • Maximum slope violation: Flagged as violating maximum slope
4. Cover is check along entire length; 1/3 rule is applied:
   • If a violation is found within the first 1/3 of the length, downstream invert is held, upstream invert is lowered.
   • If a violation is found within the middle 1/3 of the length, pipe is lowered to satisfy minimum cover at low point, slope should remain the same
   • If a violation is found within the last 1/3 of the length, upstream invert is held, downstream invert is lowered.
5. Slope is checked again:
   • If minimum slope is violated, upstream invert is held. Downstream is lowered to achieve minimum slope
   • If maximum slope is violated by constraints within the structures or by a user’s edits, violation is flagged and slope remains unchanged.
Cover Only: This rule does exactly what the name implies, lays out pipes where elevations are determined according to a specific depth below a surface or existing ground.

This rule ensures that the minimum cover is met along the length of the pipe, and also validates that both the minimum and maximum cover values are not violated along any length of the pipe. The parameters are as follows (best explained by the Civil 3D Help):

Maximum Pipe Cover: Specifies the maximum cover of soil over the pipe, based on the surface being referenced by that pipe. If the pipe cover exceeds the maximum cover value, a rule violation occurs for that object. Note that this parameter provides validation only; it does not alter (move or resize) the part in the drawing in any way. It simply produces a rule violation on the part if the specified value is exceeded.

Minimum Pipe Cover: Specifies the minimum cover of soil over the pipe, based on the surface being referenced by that pipe. During layout, a pipe will be created that attempts to maintain the minimum cover. If the pipe is edited so that its cover is less than the minimum cover value, a rule violation occurs for that object.

Length Check: This rule does not actually prevent you from drawing pipes that are too long or too short, but rather flags them as a violation to be addressed manually by the user.

Important in the release of Civil 3D 2012 (because of the Set Pipe End Location rule) is the fact that this rule the pipe is measured from pipe end to pipe end, and in no way is determined by edge of structure.

This rule is useful for design situations that require or recommend a maximum, continuous pipe length. This rule also includes a minimum pipe length warning option. The parameters are as follows (best explained by the Civil 3D Help):

Maximum Pipe Length: This parameter lets you define a maximum length for pipes. When this parameter (rule) is in use, you can still draw pipes that exceed the defined maximum pipe length. However, the object will be displayed with a warning icon in the Prospector list view. Note that this parameter provides validation only; it does not alter (move or resize) the part in the drawing in any way. It simply produces a rule violation on the part if the specified value is exceeded.

Minimum Pipe Length: This parameter lets you define a minimum length for pipes. When this parameter (rule) is in use, you can still draw pipes that are shorter than the defined minimum pipe length. However, the object will be displayed with a warning icon in the Prospector list view. Note that this parameter provides validation only; it does not alter (move or resize) the part in the drawing in any way. It simply produces a rule violation on the part if the specified value is not met.
Pipe to Pipe Match: This rule is for when drawing pipes only, and determines the elevation based on the settings within. It also determines how pipes match up when inserting into an existing pipe.

This rule applies only during the following conditions:

- Creating a pipe network that has pipes only (no structures)
- Breaking into an existing pipe with another pipe
- Connecting a pipe to a null structure (pipe to pipe connection with no structure)
- Connecting a pipe to an existing pipe end

This rule manages conditions so that only continuous runs of pipe are created as typically expected. In pipe networks where the pipe size is constant, pipes connected to other pipes must to match end to end. In pipe networks where pipe sizes change, the point where pipes match may change, depending on the type of system. For example, in pressure systems, it may be typical to match the pipe centerline. In gravity systems, it may be typical to match the crowns of the pipes.

This rule also incorporates a drop value for cases where a pipe-to-pipe connection requires a drop amount. The parameters are as follows (best explained by the Civil 3D Help):

**Match Location:** This parameter controls whether the inserted pipe holds to the pipe’s invert, crown, or centerline elevation (location).

**Drop Value:** The drop value allows you to specify an additional drop amount at pipe to pipe connections.
Structure Rules
There are 3 types of Structure Rules in Civil 3D 2012.

Pipe Drop across Structure
This rule compares all pipes connected to a single structure and ensures that pipes enter and exit the structure according to the specified drop value.

This rule applies to junction structures only and is intended specifically for gravity-based systems. It is important to note that this rule does not alter the structure in any way, nor does it alter any of the pipes that are connected to the structure. Instead, this rule actually inserts data onto the structure that is read by the pipes when they are using rules. It ensures that the following conditions are achieved when connecting a new pipe to a structure that already has one or more pipes connected to it:

- A pipe exiting a structure is no higher than the lowest pipe entering the structure.
- A pipe entering a structure is no lower than the highest pipe exiting a structure.
- There is always a specified minimum drop distance between the lowest incoming pipe and the highest outgoing pipe.

The drop can be based on a comparison between the crowns, inverts, or centerlines of pipes. A validation check is performed for drops exceeding a certain distance. This determines whether a maximum drop value is violated or whether a drop is required. The parameters are as follows (best explained by the Civil 3D Help):

- **Drop Reference Location**: Specifies the drop location by referencing the pipe’s invert, crown, or centerline elevation.
- **Drop Value**: Specifies the drop value between the lowest incoming pipe and the highest outgoing pipe connected to the structure.
- **Maximum Drop Value**: Specifies what the maximum drop value is between the lowest incoming pipe and any outgoing pipe connected to the structure. Note that this parameter provides validation only; it does not alter (move or resize) the part in the drawing in any way. It simply produces a rule violation on the part if the specified value is exceeded. This is intended to raise awareness when a drop structure might be needed.
Maximum Pipe Size Check
This rule checks to see if pipes entering a structure have a diameter or width that exceeds a specified maximum value.

This rule analyzes all pipes attached to a structure and checks to see whether the pipe diameter or width is within the specified maximum value. For example, a manhole that is three feet wide in diameter may not be able to accommodate a pipe that is three feet wide in diameter.

The one and only parameter that governs the behavior of this rule (best explained by the Civil 3D Help):

- **Maximum Pipe Diameter or Width:** For circular pipes, this parameter measures the pipe diameter. For rectangular pipes, it measures width. If a pipe diameter or width exceeds the maximum value, a warning is issued on the structure. Note that this parameter provides validation only; it does not alter (move or resize) the part in the drawing in any way. It simply produces a rule violation on the part if the specified value is exceeded.
Set Sump Depth
This rule sets the sump elevation of junction structures based on the user-specified parameters and the invert elevations of pipes attached to the structure.

When this rule is applied, the elevation of the inside bottom (sump) of the structure is calculated by subtracting the user-specified sump depth from the elevation of the lowest invert in the structure.

The one and only parameter that governs the behavior of this rule (best explained by the Civil 3D Help):

**Sump Depth:** Specifies the sump depth, or the vertical distance from the invert of the lowest pipe attached to the structure to the inside bottom of the structure.

Sump depth can is also sometimes confused with the floor thickness (FTh) of a structure, especially in profile view. This is especially evident when vertical exaggeration is used in the profile view. This is due to the floor thickness of the structure. Although not recommended as it will not depict the true dimensions of a structure, you can edit the floor thickness (FTh) in part builder to reflect what would appear to be a “true” sump depth of 0.00’. This process is explained in depth under the “customization” section.

Import and Export
Civil 3D pipe networks are a bit unique in the application due to the fact that they can be exported into built in analysis extensions within Civil 3D, then turned around and be imported directly back in. With the
availability of both the Hydraflow extensions and Storm and Sanitary Analysis this practice can become quite commonplace. There are some options and settings available to make this a quick and painless process, but in turn there are some things to keep an eye on.

**LandXML**
Due to the universal usage of the LandXML schema, this is a very popular option to move pipe networks from Civil 3D drawing to drawing, it is also widely used when sharing pipe data between different applications. Civil 3D includes some built in settings to aid this process and help match parts as they come into the application.

In the LandXML settings there are option to configure the import settings of pipe networks. Here you can select the Parts List for part family size matching, as well as match up the pipes and structures with the desired part from the specified parts list.

![LandXML Settings - Drawing1](image)

**Import and Export Storm Sewer Data**
As mentioned above, pipe network are unique as they can be analyzed within built in extensions in Civil 3D. This means that the import and export process will most likely be used fairly often during the design process. In order to streamline this process there are Storm Sewers Migration Defaults to set up in both the `ImportStormSewerData` and `ExportStormSewerData` command settings under Pipe Networks in the Settings tab of Toolspace. Use these settings to establish the defaults for part matching, and the default parts list, used when migrating pipe network data between the Storm Sewers Extension or Storm and Sanitary Analysis and AutoCAD Civil 3D. The four options best described by the Civil 3D HELP menu are as follows:

**Part Matching Defaults**: Specifies the defaults used for part matching when migrating pipe network data between the Storm Sewers Extension or Storm and Sanitary Analysis and AutoCAD Civil 3D.

**Parts List Used For Migration**: Specifies the default parts list used when migrating pipe network data between the Storm Sewers Extension or Storm and Sanitary Analysis and AutoCAD Civil 3D.
Allow Part Family Swapping: Set to Yes if you want to allow the STM file import to overwrite the Part Family. This setting swaps parts upon import if the "expected" Part Family (from the Storm Sewers Migration Defaults or from the Part ID found in the STM file, depending on the Use Imported Part ID For Part Family setting below) is different than the current AutoCAD Civil 3D Part Family, for each part being updated.

Note: The "expected" Part Family depends on the Use Imported Part ID For Part Family setting. Allow Part Family Swapping must be set to Yes in order to use the Use Imported Part ID For Part Family setting below and to use an XML file for part matching.

Set to No if you want the STM file to preserve the original part family associations. AutoCAD Civil 3D will maintain the current AutoCAD Civil 3D Part Family, regardless of the Storm Sewers Migration Defaults settings. Setting this to No allows only dimensional values to change within the part's current Part Family, as follows:

**Pipes**
- Diameter, or Height and Width
- Manning's n value
- Slope
- Length
- Location data (coordinates and elevations)

**Structures**
- Length and Width
- Location data (coordinates and elevations)

Use Imported Part ID For Part Family: For Use Imported Part ID For Part Family, do one of the following:
Note: If Allow Part Family Swapping is set to No, then the Use Imported Part ID For Part Family setting has no effect.

Set to Yes to allow parts to be changed to the Part Family indicated in the Part ID of the STM file. If Allow Part Family Swapping is set to Yes, and Use Imported Part ID For Part Family is set to Yes, the part's Part Family will be changed to the Part Family indicated in the Part ID of the STM file.

Set to No to use the Import settings in the Part Matching Defaults. If Allow Part Family Swapping is set to Yes, and Use Imported Part ID For Part Family is set to No, the part's Part Family will be changed to the Part Family indicated by the Storm Sewers Migration Defaults Import settings.

Note: Setting this to “No” maintains the behavior of AutoCAD Civil 3D prior to the 2012 version.

**Setting Part Matching Defaults for Migration**

You must set part matching defaults before migrating pipe network data between AutoCAD Civil 3D and Storm Sewers or Storm and Sanitary Analysis.

Setting the part matching defaults enables you to choose the specific AutoCAD Civil 3D part types that will be matched up with Storm Sewers part types when you import and export pipe network data between AutoCAD Civil 3D and Storm Sewers.

Performing this task helps avoid error messages during migration, and ensures that AutoCAD Civil 3D part types are recognized as appropriate part types in the Storm Sewers Extension and vice versa.

You may only have to perform this procedure once. However, if you are adding, deleting, or changing part types after import or export, then you would need to perform this procedure again to ensure that parts are appropriately matched between the two applications.

**Troubleshooting Tips**

**Pipe Networks**
As with anything in Civil 3D sometimes the expected result is a bit different than what actually is displaying within your drawing. Pipe Networks are no different and the following tips can hopefully help minimize some of the downtime these types of issues can cause.

**LandXML**
This is one of the best ways to see if the issues you are experiencing in your pipe network are related to specific drawings or the pipe data itself. If you notice some strange behavior with your network, quickly LANDXMLOUT into a new drawing. If it works in the new drawing, try LANDXMLIN after deleting the original network in the original drawing and see if you then get the desired results. The process of illumination and the ease of the LandXML import/export makes this an excellent tool.
**FACETDEV**

You may have noticed your pipes in section view and they look like octagons rather than the nice 12” RCP that was drawn in plan view? If so this is caused by the setting FACETDEV which is best described in the HELP menu:

*The number you specify for facet deviation defines the maximum distance from the chord to the arc—the chord being an edge that is created from faceting the curve to the true mathematical arc. The facet deviation has a range of greater than zero (0) and no upper limit. The lower this variable is set, the more segments will be used to draw the pipe. The minimum number of segments is 8.*

![Diagram showing octagon and circle comparison](image)

**Display Manager Settings**

Having trouble viewing the designed network? All the normal places you would look such as layers, style, etc. all checked out fine. Have a look at the Display Manager.

![Display Manager interface](image)

As you may or may not know, MEP deals quite a bit with pipes and piping systems, and MEP relies heavily on the DISPLAYMANAGER to display their pipes as desired.
Being Civil 3D users, we may rarely venture into the Display Manager so this may be unfamiliar territory. Check and make sure that pipes and structures are checked under REPRESENTATIONS BY OBJECT in both Model and Plan views. Once checked, the pipe network may now displayed as expected.

So although this may be a rare instance, it is another place to put on your checklist when troubleshooting drawings with display issues.

**Sump Depth 0.000’?**

Ever wonder why a sump depth set to 0.000’ always appears to be a bit higher than the zero values specified in the rules? Everything looked fine from the part properties, however when placed in Profile View, the sump did not appear to be at 0.000’ as defined by the rules.

The fact is that the sump can be set at 0.000’, and what is displayed is actually the Floor Thickness (FTh) parameter of the part. This parameter is easily edited in Part Builder to get your pipes in profile view to display as desired. Much like as described earlier in the this document, the only parameter that will need editing will be the FTh parameter and adding a 0.0000 value.

![Part Builder screenshot](image.png)

Once this value is added through Part Builder, all that needs to be done is save and validate the Part Family, and the command PARTCATALOGREGEN to refresh the catalog within the drawing. At that point the 0.000’ Floor Thickness can be changed right within your structure properties and also through your Parts List to give you the appearance of a “true” 0.000’ sump depth.

*Please note that this method is giving an incorrect representation of the structure as it essentially removes the floor of the structure. This is only suggested to be used for display purposes only.

**Runtime Part Parameter Configuration Error**

Those of you that have made custom changes to Parts List and added Optional Parameters, may have come across this little error message upon launching Civil 3D:
This typically occurs for one of two reasons. One being that your AeccPartParamCfg.xml file has been configured incorrectly to reflect the custom parameters. The other reason being that your custom template, with these parameters added to your parts list, has been pathed to the QNEW location from OPTIONS>FILES tab>TEMPLATE SETTINGS>DEFAULT TEMPLATE FILE NAME FOR QNEW.

For information on how to correctly configure your XML file please refer to the previous section of this handout “Customizations”.

If you have noticed this error message because of your template being set in your QNEW path, this is something that Development is currently looking into. I would like to note that these error messages appear to be benign and I have confirmed that you can still use the Optional Parameters without issue after clicking the “OK” button on the error message. The downside of this would be that if you have 63 Optional Parameters, you will get 63 error messages at launch.

However if you open the template AFTER Civil 3D has launched, (leaving the QNEW pointing to something like the stock NSC template) you will not get these error messages. So although it may not be ideal, you can still use these Optional Parameters effectively in your designs.

**Keep Learning!**

Keep your Civil 3D skills sharp and be aware of the latest developments by staying up to date all year long. Many free resources are available at your disposal:

**Autodesk Discussion Groups**

You will find many super users offering opinions, solutions, and suggestions in the pages of the Civil 3D Forums. Additionally Autodesk Support is very active in the forums, as well as the occasional appearance from our Development Team. [http://forums.autodesk.com/t5/AutoCAD-Civil-3D/bd-p/66](http://forums.autodesk.com/t5/AutoCAD-Civil-3D/bd-p/66)

**Blogs**


From the Ground Up: [http://www.autodesk.com/fromthegroundup](http://www.autodesk.com/fromthegroundup)

Twitter:

I find that this tool is very useful on keeping up with various Civil 3D users, and most blogs and websites publish tips and tricks through this format. Its quick and easy, and a good way to filter through a lot of information in a short amount of time. You can find me http://twitter.com/SethHall

*Data used in this handout was obtained from the Honolulu Land Information System, and available to download for free here: http://gis.hicentral.com/