

Schedule Anything in AutoCAD Architecture or AutoCAD MEP

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AB500-3 This extended session includes detailed coverage of the scheduling capabilities of AutoCAD Architecture and AutoCAD MEP. Learn the basics of creating custom schedules for virtually any object you can draw or model, then tackle the more advanced property sets such as Location, Project, Classification, Anchor, and Material. Discover the tricks to tagging and scheduling objects embedded within the external references of a large project.

About the Speaker:

A registered architect with over 20 years of experience in Autodesk architectural applications, Matt has worked with AutoCAD Architecture since its initial release. Matt is an Autodesk Certified Instructor at an Autodesk Authorized Training Center. In addition to assisting customers in implementing Autodesk Architectural Desktop and Autodesk Revit platform products, he has also consulted with Autodesk development staff in product design and usability for AutoCAD Architecture and also co-authored *Architectural Desktop 2007 - an Advanced Implementation Guide (Second Edition)*. Matt has consistently been a highly rated instructor at Autodesk University since he began presenting in 2000.

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Schedule Concepts and Terms

The scheduling tools included with AutoCAD Architecture and AutoCAD MEP provide you with the mechanism to schedule virtually any type of item and include almost any type of data you need about that object. Schedules are dynamically linked to the objects that they document; changes to the objects will result in changes in the schedule. Critical concepts to remember about schedules include:

- **Schedule data resides on the object being scheduled.** There is no need to create block attributes, for example, to generate a schedule. The data exists on the object itself. Modifying the object will directly modify the schedule.
- **Schedule data is “attached” to the objects as *Property Sets*.** Without an appropriate property set attached to an object, its data will appear as question marks in the associated schedule. Property sets are attached in a variety of automatic, semi-automatic and manual methods which we will explore later.
- **Any object can be scheduled.** This includes generic AutoCAD blocks and primitive objects as well as objects created with AutoCAD Architecture or AutoCAD MEP.
- **Schedules are fully customizable.** You can create your own sets of properties and create your own custom *schedule table styles* to accommodate almost any scheduling need you may have.

Terminology

To work with schedules and schedule data, there are some basic terms that you need to understand:

- **Property Set Definitions** are defined in Style Manager and consist of a list of all of the properties for an object that you would like to be able to include in a schedule. Without this list of properties, you can't create a schedule table style and you cannot “attach” the data for scheduling. Property sets come in two basic forms, *automatic* and *user-defined*.

Automatic properties cannot be edited by the user, but get their values directly from the objects. An example of this type of property would be a door's width. Automatic properties can also come in the form of formulas which derive their properties from a combination of other properties and perhaps some mathematical functions, locations and project-source properties. These will be covered and will make more sense later.

User-Defined properties are in some ways very analogous to traditional block attributes, in that their values are assigned by the user and are not a parametrically defined property of the object. Examples, again, for a door would be fire rating, manufacturer, lockset and hardware, to name just a few possibilities.

- **Object-based property sets** contain properties that are attached directly to individual objects. This means that properties can vary from object to object, even if they are on the same style. These types of property sets are attached to an object by tagging it or by manually attaching the property set (the methods for doing this are discussed later).
- **Style-based property sets** contain properties that in the case of user-defined values, apply to all objects on that style. For example, if you assign “fire rating” as a style-based property to a door style, editing the value for that property for any door will mean that you are actually editing the value for all doors of that particular door style. Automatic, style-based properties can be different from object to object however (it would be a bit ridiculous to expect all doors of a specific style to have the same width). Style based properties are typically attached by editing the style itself (again, we'll look at exactly how this is accomplished a bit later).

- **Data Formats** are what control how a property is to appear in a schedule. A door width, for example, would be 36.0 as reported by the raw property that is attached to the door. A data format can be created and applied to that raw property to cause it to be reported as 3'-0" in the schedule or tag. In most cases, you shouldn't have to create a new data format style, since several already exist in the sample style drawings and templates that come with AutoCAD Architecture.
- **Schedule Table Styles** define the appearance and contents of a schedule, and what types of objects can be included. It is in the schedule table style that you define the columns, their order, text formatting, lineweights and color, schedule title, sorting, etc. You cannot create a complete schedule table style until you have defined one or more property set definitions that apply to the object type(s) for which you are creating your schedule.
- **Schedule tags** (or object tags) are annotation items that will reflect property data that is attached to an object. For example, if one of the properties of a door is its door number, then a tag can be created that will reflect that value. Editing the door's property data and changing the door number will update both the schedule and the tag associated with the door. These tags are placed using a *tag anchor*, however this is a fairly automated process and is invisible to the user.

How It All Fits Together

Now that we've got some of the terms taken care of, how do they all interact? A Property Set Definition defines the bits of data that we want to be able to show in a schedule. In the schedule table style definition, these properties can become columns. When the properties are attached to an object, the schedule table that is based on that schedule table style will display those bits of data. Figure 1 shows the relationship, but essentially the most critical aspect of the whole scheduling mechanism is the existence of property sets.

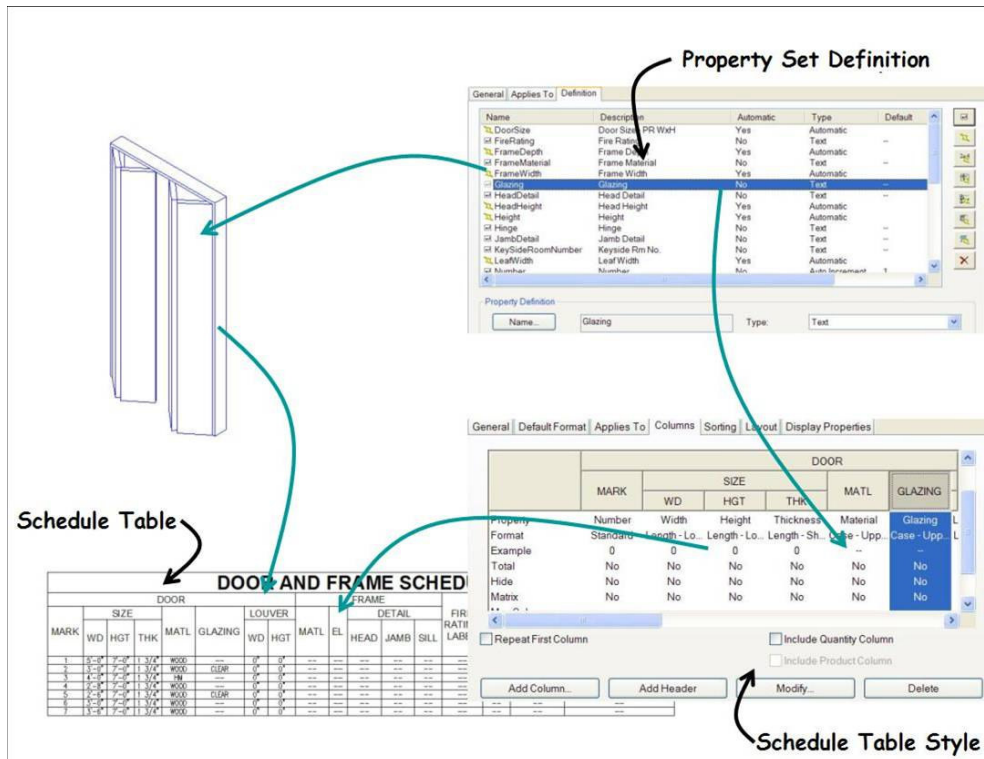


Figure 1. How it all fits together.

Working with Schedules

Regardless of whether you use the schedules that are provided with AutoCAD Architecture or whether you customize your own, the process of working with schedules and schedule data on a day to day basis will be the same. As stated previously, before anything can really be reported in a schedule, it must first have property data attached to it, either at the style or object level, or both. As an example, we'll stick with doors for now.

Style-Based Property Sets

All that is necessary to start with is to place some doors in a drawing. To illustrate the difference between style-based property sets and object-based property sets, we'll use some of the stock content that comes with AutoCAD Architecture. Follow these steps:

1. Create a wall in your drawing that is long enough to contain 4 or 5 doors.
2. Using the "Door" tool on the "Design" tool palette, place two doors using the "Standard" door style. Make their sizes different.
3. Move to the "Doors" palette and place two doors using the "Hinged Single" style. Again, make them different sizes.
4. Move to the "Documentation" palette and select the "Door Schedule" tool, following the prompts as below:
5. Select objects or ENTER to schedule external drawing: *Place a window around all of the doors in your drawing and press <ENTER>*
6. Upper left corner of table: *Pick a point near your wall*
7. Lower right corner (or RETURN): *Drag the other corner so that your schedule just fits on your screen (normally you would hit <ENTER> here to make the schedule come in at the proper scale for plotting).*

Your schedule should look something like Figure 2.

DOOR AND FRAME SCHEDULE																
MARK	DOOR						FRAME						FIRE RATING LABEL	HARDWARE		NOTES
	SIZE			MATL	GLAZING	LOUVER		MATL	EL	DETAIL				SET NO	KEYSIDE RM NO	
	WD	HGT	THK			WD	HGT			HEAD	JAMB	SILL				
?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
?	?	?	?	--	?	0"	0"	--	--	--	--	--	?	?	?	?
?	?	?	?	--	?	0"	0"	--	--	--	--	--	?	?	?	?
?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?

Figure 2. The Door Schedule.

What happened? Notice that most of the cells have question marks in them, but some have a value ("—" and "0" are valid values). The cells that have a value indicate properties that are style-based, and they correspond to the doors that were inserted from the "Doors" palette. To verify this, select one of the last two doors that you inserted. Right click and select "Edit Door Style". In the door style editor, go to the "General" tab and select the "Property Sets" button. You should see a dialog box similar to Figure 3. These are the properties that were attached to the door style. Note that there are actually two sets of property data attached "DoorStyles" and "FrameStyles". Also notice the lightning bolts next to some of the data. This indicates an automatic property source that you cannot edit in this dialog. Those values will be

a function of the door's parametric properties. ("FrameDepth" and "FrameWidth" are derived from the dimensions specified in the "Dimensions" tab of the door style). Select <Cancel> until you exit all dialogs.

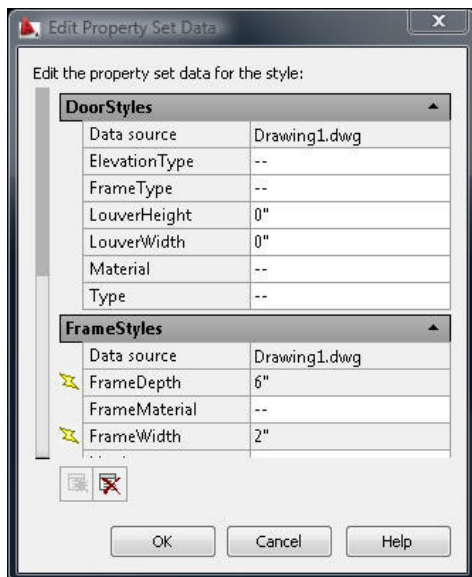


Figure 3. The Properties attached to the door style.

So what about the question marks? These indicate values for which no properties have currently been attached. First, we'll edit the "Standard" door style to attach the same property sets that the "Hinged Single" style has, then we'll look at how we can attach the rest of the properties to the doors to fill in the missing cells.

Select one of the first two doors that you placed in your wall, right-click and select "Edit Door Style". On the "General" tab, select "Property Sets". The dialog box that appears will look blank because currently there are no property sets attached. However if you look closely in the lower left area of the dialog box, you'll find a button. Hovering your cursor over the button should give you a tooltip that reads "Add Property Sets". Select the button to see a list of all property sets in the current drawing that apply to doors. Make sure that "DoorStyles", "FrameStyles" and "ManufacturerStyles" are all selected, then select "OK" until you return to the drawing editor. Your schedule should now have a diagonal slash through it (if it doesn't then it has either already updated or the "out of date" marker has been turned off in your display control). If you have the diagonal line, select the schedule, right-click and select "Update Schedule Table". Now all of the doors should have some of the cells populated (there will still be lots of question marks, indicating un-attached object-based properties, as well).

Automatic Update

Before dealing with the rest of the properties, let's make a modification to the schedule so that we can see the effect of our changes immediately, without updating. Select the schedule, and go to the Properties screen. Under the "General" category, change the setting for "Update Automatically" to "Yes". Now, instead of getting the "Out of date marker" when you modify an object that is in the schedule, the changes will be reflected immediately. (Note: this is a drain on system resources and in a large drawing you may notice a significant slowdown when editing objects. For that reason, it is probably best in a production environment to leave the "Auto-Update" feature turned off, updating the schedule periodically on your own, and relying on the "Out of Date" marker to inform you when the schedule is out of date.

Additionally, it is common to schedule objects that exist in an attached XREF or even in an external drawing that is not even referenced to the current file, which makes the “Auto-Update” feature moot.)

Object-Based Properties

There are three ways of attaching object-based properties:

- Properties screen** – Select one of the doors (it doesn’t matter which one), then go to the “Extended Data” tab of the Properties screen. Select the “Add Property Sets” button in the lower left corner of the dialog and attach the “DoorObjects” property set. You should immediately see a change in the schedule. One of the doors no longer has any question marks in any of its cells. You should also notice that the door width and height cells now have a value. These are automatic properties that simply needed to be “turned on” to enable them to display in the schedule.

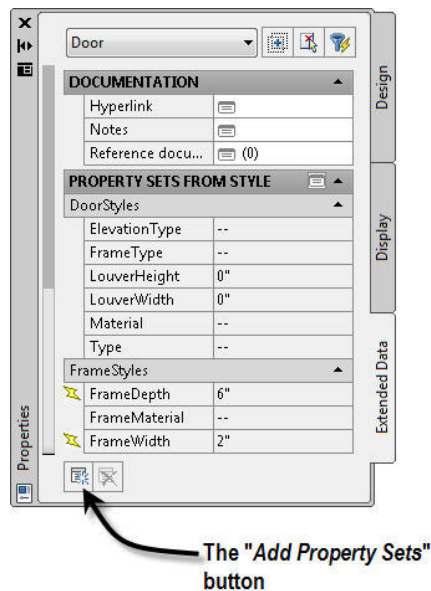


Figure 4. Attaching Property Sets using the Extended Data tab of the Properties screen.

- Tagging** – If you use one of the “smart” object tags that come with AutoCAD Architecture, any object-based property sets required by the tag will automatically be attached to the objects as you place the tags. Navigate to the “Annotation” tool palette and find the “Door Tag” tool shown Figure 5. (*Do not select the “Door Tag – Project Based” tool – this will work differently. We will look at project properties later.*) Select the “Door Tag” tool and follow the prompts:

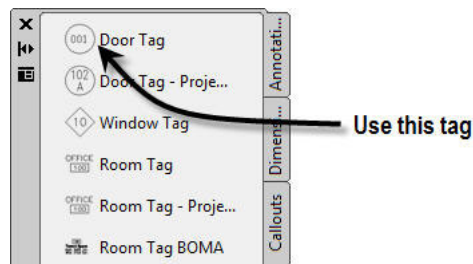


Figure 5. The Door Tag tool.

Select object to tag [Symbol/Leader/Dimstyle/Edit]: *Pick the door you just edited.*

Specify location of tag <Centered>: *Press <ENTER> to center the tag on the door. When the property set screen comes up, select "OK" without making changes (although you could fill out any non-automatic properties here). The tag should now be placed with a door number visible. The schedule won't look any different, because this particular door had the properties attached already from the previous step.*

Select object to tag [Symbol/Leader/Dimstyle/Multiple/Edit]: *Pick one of the other doors.*

Specify location of tag <Centered>: *Press <ENTER> to center the tag. Again, select "OK" in the property set screen and notice, again, this door now has been assigned a number and all of the properties are visible in the updated schedule. In this case, the tag added the "DoorObjects" property set to the door.*

Select object to tag [Symbol/Leader/Dimstyle/Multiple/Edit]: *Press <ENTER> to end the command.*

Tip: If you don't want to have the properties screen appear every time you add a tag, you can disable it by turning off the "Display Edit Property Data Dialog During Tag Insertion" setting in the "AEC Content" tab of the OPTIONS dialog box, however leaving this on gives you the opportunity to enter user-defined values as you tag, rather than come back and add the information later.

- **Using the "Add All Property Sets" feature of the schedule** – There are still two doors that don't have all of their properties attached. Select the schedule, right-click and select "Add All Property Sets". The schedule should now be updated with data for all doors in all cells. You could still tag the remaining doors, in which case the tag would not need to attach the property sets, but would simply reflect the values that are already now in place.

Editing Schedule Data

If you need to make a change to the data in the schedule, where do you do it? First, it is important, once again, to remember that the schedule is merely a reporting device, and that the actual data is on the objects themselves. Also remember that if you find a property that seems to be "uneditable", that simply means that it is an "Automatic Source" property, which is changed by editing the object itself (for example, the door width). User defined properties will be either style-based or object-based.

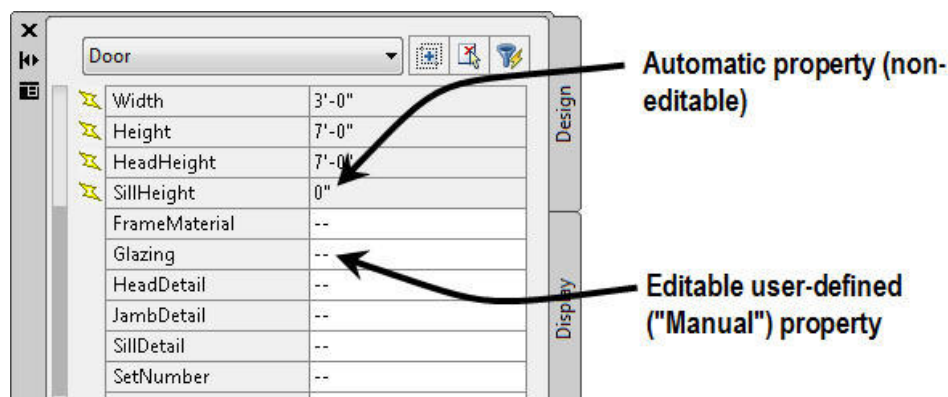


Figure 6. Automatic and User-Defined Properties in the Extended Data screen.

- **Object-Based properties** will be displayed in the “Extended Data” tab of the Properties screen, and can be edited in that location. Select the object whose properties that you want to edit, then go to the Properties screen to edit them. (You can also select multiple objects if they have the same property sets attached to them).

To illustrate this method, select one of the doors that you placed earlier. In the Properties screen, select the “Extended Data” tab. You should be able to see all of the object-based properties. Edit the value for “FireRating” to “90 MIN.” You should see the schedule update immediately, since it is set to “Automatic Update”. Notice also that any field that has a lightning bolt next to it is visible, but not editable. These are automatic properties that are edited by changing a parametric property of the door.

- **Style-Based properties** can be seen in the Object Properties screen, however to edit them you must either edit the style itself, or select the small “Edit Style-Based Properties” worksheet icon in the Properties Screen (which is, essentially editing the style). If you choose to edit the object style directly, go to the “General” tab, select “Property Sets”. You will be placed in an editor similar to the one that is provided with the Object Properties screen. Remember, however, that any changes made to the style-based properties will affect all objects on that style, not just the one that you selected.

To try this out, select the same door for which you changed the fire-rating label, right-click and select “Edit Door Style...”. On the “General” tab, select “Property Sets...”. The next screen will look similar to the Properties screen, however remember you are editing the door style; any changes you make will affect every door on that style. Under the property set header “DoorStyles” change the “Material” value to “WOOD” and select “OK” until you exit all dialog boxes. You should notice that the value for the “Material” column has been updated for more than one door in your drawing.

An alternative method of editing user-defined properties, whether they are style-based or object-based, is to edit them in the schedule itself. To do this, select your schedule, right-click and select “Edit Table Cell”. Without selecting anything in the schedule at first, move your cursor across some of the cells and note that as you do, the object in the drawing that the cell is linked to will highlight. Select one of the empty cells under “Fire Rating Label” and change the value to “60 MIN.” (Note that you could also edit other object-based properties of the associated door here as well). Next, use the same command to select one of the empty cells under the Door Material header. You should get a warning dialog telling you that you are editing a style and may be affecting more than one door in the drawing. Select “Yes” to continue and change the material value for the door. (Again, notice that you can edit multiple style-based properties here also.)

Schedule Utilities

- If you select a schedule and right-click, you can select “Selection” and get four options for managing the objects that are reported by the schedule. Two that you might find most useful are:
 - **Add** – allows you to add new objects to the schedule. Note that if you have the “Add New Objects Automatically” option switched on in the schedule properties this is unnecessary. Also, this only applies if the schedule is in the same drawing as the objects being scheduled.
 - **Remove** – allows you to select objects to remove from the schedule report. Again, this only applies if the schedule is in the same drawing as the objects.

- When you are in a table cell editing mode, you can select a cell with the <CTRL> key pressed to ZOOM to the object whose data you are editing.
- From the right-click menu when a schedule is selected, there is an “Export” option that will allow you to write your schedule out to an Excel spreadsheet, maintaining the basic formatting that your schedule has in the drawing. This is a one-way transfer, with no link maintained to the original data.
- On the “Documentation” tool palette, the “Browse Property Data” tool will allow you to see all of the object-based property sets in use in your drawing, as well as edit the data. Note in Figure 7 there is also an option to highlight the objects in the drawing editor when they are selected in the property data browser window.

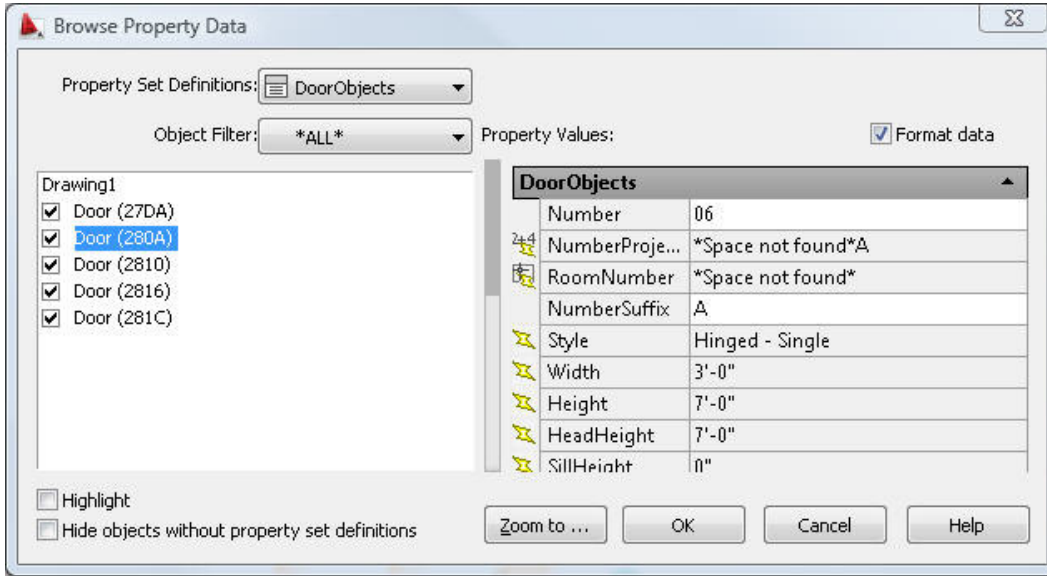


Figure 7. The Browse Property Data dialog box.

Working with External Data

The data that your schedule is reporting does NOT have to exist in the same drawing that the schedule is in. There are two ways to have your schedule in a different drawing from the objects that it is reporting:

- **Use External References** – If you reference a drawing that has objects with schedule data attached (that is, the property sets are attached to the objects), the schedule will read the objects from inside the XREF. Additionally, if data has not been attached to the objects, you can still tag them or use the “Add All Property Sets” feature of the right-click menu, even though they do not actually exist in the drawing that your schedule is in. If you need to edit the data associated with the referenced objects, you can still do so using the “Edit Table Cell” command from the schedule right-click menu or the “Browse Property Data” tool.

- Schedule an External Drawing** – When you create the schedule, you can press <ENTER> instead of selecting any objects. When you place the schedule, only the schedule title and headers will show. The next step is to select the schedule, navigate to the Object Properties screen and change the setting for “Schedule External Drawing” to “Yes”. Next, also in the Object Properties screen, select the name of the drawing containing the objects to be scheduled (you can also browse for it). Note that you can not attach schedule data from the schedule drawing, nor can you edit any of the data. It must be attached and edited in the drawing in which the objects exist.

Custom Schedules

You can create a schedule for virtually any type of object in AutoCAD Architecture or AutoCAD MEP. If it can be drawn, inserted or modeled, you can define properties for it and report those properties in a schedule table, whether it is a polyline, a door or a duct. For the sake of consistency, we’ll continue with doors as a working example, but remember, the same concepts and procedures will apply regardless of the object type and regardless of whether you are using AutoCAD Architecture or AutoCAD MEP.

Creating the Property Sets

Since you can’t do anything as far as schedules are concerned until you have properties to include in the schedule, the first task is to create the property set definitions that we’ll need for the schedule.

Data Format Styles

Before creating property set definitions it’s a good idea to make sure you have any required data format styles created and present in your drawing as well. Data format styles are pre-configured formatting codes for your properties and will control how numbers are formatted as well as text. In most cases, you don’t need to create a new one, as several already exist that will handle most needs. To get access to or create data format styles, activate Style Manager. Under “Documentation Objects”, look in the “Property Data Formats” category. You should have the data format styles shown in Figure 8 in your drawing. If you don’t, then, still in Style Manager, open the “Schedule Tables (Imperial).dwg” or “Schedule Tables (Metric).dwg” file in the folder where your AEC Content is stored. (You can find this folder quickly in the Open File dialog box by using the “Content” shortcut in the shortcuts bar on the left side of the dialog.) In the “Schedule Tables (Imperial).dwg” or the “Schedule Tables (Metric).dwg”, find the “Property Data Formats” category and drag the data format styles from that drawing into your current drawing.

Style	Description
ab Area	Area calculations
ab Case - Upper	Upper case text
ab Length - Long	Architectural Units with 1/4 inch precision
ab Length - Nominal	Architectural Units with 1 inch precision
ab Length - Short	Architectural Units with 1/16 inch precision
ab Number - Object	Object numbering format
ab Standard	Standard

Figure 8. The default Data Format Styles that come with AutoCAD Architecture and AutoCAD MEP.

Plan the Property Sets

We need to determine what data we want in the schedule and tags, where that data is going to exist (on the style or on the objects) and where it is going to come from (Automatic source or User-Defined). The following table is what we'll start with:

Property	Location	Source
DoorMark	Object	User-Defined
DoorWidth	Style	Automatic
DoorHeight	Style	Automatic
DoorSwing	Style	Automatic
DoorHardware	Object	User-Defined
DoorFireRating	Style	User-Defined
DoorMaterial	Style	User-Defined
DoorRemarks	Object	User-Defined

In this example, we are setting all Automatic-source properties to reside on the door style. By attaching them to the style, they will be in place at the time the doors are inserted into the drawing, with no further action needed on the part of the user. The only object-based properties are those user-defined values that we've decided must be able to vary from one door to the other. Values such as the door material and fire rating we've decided will be the same for every door on a given style, so we're making them style-based. When you decide your own scheme, you will want to weigh the benefits and disadvantages of each method, and how it best suits your situation.

Define the Property Sets –

Using Style Manager, select the "Property Set Definitions" entry under "Documentation Objects", right-click and select "New". Name the new property set definition "AU-DoorObjects", then double-click on it to go into the editor. On the "General" tab you can enter a description if you like, then move to the "Applies to" tab. Make sure "Applies to" is set to "Objects", then clear all entries except for "Doors". (Use Figure 9 as a guide). On the "Definition" tab, there is a vertical row of buttons on the right side to add various types of property definitions. The top button is for user-defined properties and the rest are for various types of automatic-source properties (see Figure 9).

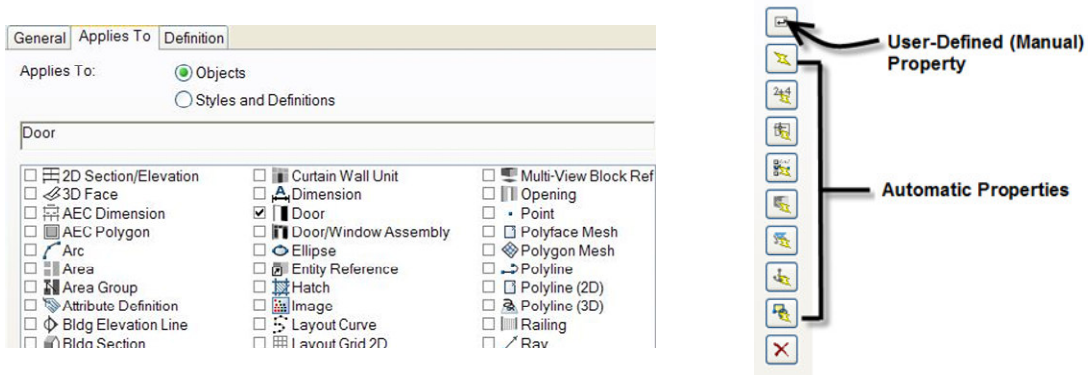


Figure 9. Defining Property Sets and Properties.

To define the first property (DoorMark), select the top (“User-Defined”) button. In the next dialog box, provide a name of “DoorMark” and select “OK”. The property definition will appear in the main window of the editor, however it needs more editing. Below the main window, change the description to “Door Mark” (with a space). Change the “Type” attribute to “Auto Increment – Integer”. This will cause door numbers be unique to each object. Note that you can also increment characters. Set the “Default” attribute to 1, which will cause the incrementing to start at that value. Set the “Format” attribute to the “Number – Object” data format style, which will cause all single digit numbers to be preceded with a zero. (You can see the result in the “Example” field below the “Format” attribute). Once you have finished the “DoorMark” property definition, create the rest of the object-based definitions so that your completed “AU-DoorObjects” property set definition looks like Figure 10 (for now don’t worry about the “Units”, “Visible” and “Order” columns – we will look at these a bit later):

Name	Description	Type	Source	Default	Units	Format	Example	Visible	Order
DoorHardware	Door Hardware	Text		--		Case - Upper	--	<input checked="" type="checkbox"/>	
DoorMark	Door Mark	Auto Increment - Integer		1		Number - Object	01	<input checked="" type="checkbox"/>	
DoorRemarks	Remarks	Text		--		Case - Upper	--	<input checked="" type="checkbox"/>	

Figure 10. The object-based door Properties.

Note that even there is no real “Default” value specified for some of the User-Defined properties, we specify a “- -” value anyway. This way, there’s something to select in the schedule later on for those cells if the user wants to use the “Edit Table Cell” command.

After defining and saving the object-based properties (just select “OK” at the bottom of the editor to return to Style Manager), use a similar process to define the style-based properties. Create a new property set definition, named “AU-DoorStyles” and set the “Applies to” value to “Styles and Definitions”. Clear all of the style and definition types except for “Door Styles”. Finally, in the “Definition” tab, define the first Automatic Source property. There are actually several types of “Automatic” property types. For now, we’ll use the generic type, which simply relies on the actual geometric properties of an object. The button for this is shown in Figure 11.

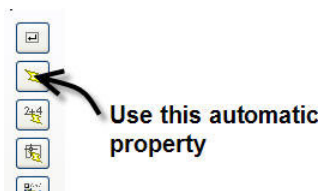


Figure 11. Add an Automatic Property.

After selecting that button, you should see a new dialog, which is listing all of the automatic geometric properties for doors and for door/window assembly styles. Notice that for “Width”, there are several types available for doors. For our example, we’ll use the door objects’ “Width – PR” property (to allow double doors to list as a pair). In the editor, since this is an Automatic source property, the only thing you need to specify is the data format, which you should set to “Length – Nominal”. Using this procedure and the one used earlier for user-defined properties define the rest of the style-based property definitions so that your editor looks like Figure 12.

Name	Description	Type	Source	Default	Units	Format	Example	Visible
DoorFireRating	Fire Rating	Text		--		Case - Upper	--	<input checked="" type="checkbox"/>
DoorHeight	Height	Automatic	Door:Height			Length - Nominal		<input checked="" type="checkbox"/>
DoorMaterial	Material	Text		--		Case - Upper	--	<input checked="" type="checkbox"/>
DoorSwing	Door Swing Direction	Automatic	Door:Swing Direction			Case - Upper		<input checked="" type="checkbox"/>
DoorWidth	Door Width	Automatic	Door:Width			Length - Nominal		<input checked="" type="checkbox"/>

Figure 12. The Door Style Properties.

Note: to change the names of the Automatic source property definitions, click on the “Name” button with that property selected after you create it. Once you have created all your style-based properties, exit the editor by selecting “OK” but stay in Style Manager.

Creating the Schedule Table Style

Now that you have the property sets defined, you can create a custom table style. In Style Manager, select the “Schedule Table Styles” category, right-click and select “New”. Name the new style “AU-DoorSchedule”, then double-click to edit it. Again, under the “General” tab you can provide a description, then go to the “Default Format” tab. This is where you specify the typical cell formatting (you can override it for specific elements later if necessary). Format the cells to match Figure 13.

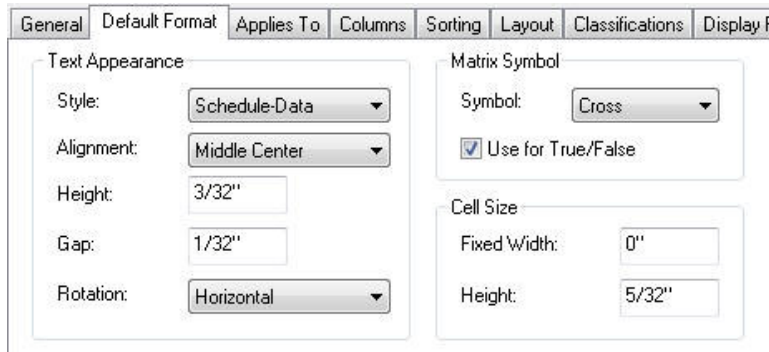


Figure 13. Setting the default cell formats in the Schedule Table Style.

In the “Applies To” tab, clear all the values but “Door”, then move to the “Columns” tab. To create your first column, select the “Add Column” button. In the next dialog, note that all of the property sets in the current drawing that apply to doors or door styles are visible for selection. If you have property sets available other than “AU-DoorObjects” and “AU-DoorStyles”, do not use them in this exercise. For the first column select the “DoorMark” property created earlier. Change the “Heading” value to “Mark” and select “OK” to add the column to the schedule style definition. Continue adding and formatting columns until you have a definition that looks like Figure 14.

	Mark	Width	Height	Material	Swing Direction	Hardware	Fire Rating	Remarks
Property Set	AU-DoorO...	AU-DoorSt...	AU-DoorSt...	AU-DoorSt...	AU-DoorStyles	AU-DoorO...	AU-DoorSt...	AU-DoorO...
Property	DoorMark	DoorWidth	DoorHeight	DoorMaterial	DoorSwing	DoorHardw...	DoorFireR...	DoorRema...
Format	Number - O...	Length - No...	Length - No...	Case - Upp...	Case - Upper	Case - Upp...	Case - Upp...	Case - Upp...
Example	01					--		--
Total	No	No	No	No	No	No	No	No
Hide	No	No	No	No	No	No	No	No
Matrix	No	No	No	No	No	No	No	No
Max Cols.								

Figure 14. Adding the Schedule columns.

Before moving to the next tab, there are some minor changes that need to be made. First, select the column headers for “Width” and “Height” while pressing the <CTRL> key, then with both headers selected, select “Add Header”, providing a label of “Size” for the header. Next select the header for “Remarks” and pick the “Modify” button. In the next dialog, select “Override Cell Format” and change the cell width from zero to 2 ½”. Cells that have a zero width will automatically expand to accommodate the longest value in that column. Cells with a fixed width will word wrap when the width value becomes inadequate for the contents. Select “OK” until you get to the main schedule table style editor dialog box.

Now that you have the columns defined, move to the “Sorting” tab and select the “Add” button. Add the “AU-DoorObjects:DoorMark” property as the property value to sort on. Note that you can sort on multiple values. For example if you were doing a room list, you could sort first on “Department”, and then the room name or room number. In this example, the door number (“Mark”) will be sufficient. Move to the “Layout” tab and provide a title of “Door Schedule”. Override the the cell format for the title and use the “Schedule-Header” text style with a height of ¼”, then override the cell format for the column header and use the “Schedule-Header” text style with a height of 1/8”.

With the schedule essentially defined, select “OK” until you exit all dialogs and find yourself in the drawing editor. To test the appearance of the schedule, go to the “Documentation” tool palette and select the “Door Schedule” tool. Immediately go to the Properties screen (before placing the schedule) and change the “Style” value to “AU-DoorSchedule” (the tool actually imports the stock AutoCAD Architecture door schedule; we need to make sure we are inserting our own custom schedule). Next, press <ENTER> (there are no objects to select in your current drawing) and pick a location for the schedule, followed by another <ENTER> to insert it at the default size. You should only see the column headers and the title right now, and they should look like Figure 15. (Note: As with all AutoCAD Architecture objects, display control is an aspect of schedule styles and you can use that to get control of the text and linework).

Door Schedule							
Mark	Size		Material	Swing Direction	Hardware	Fire Rating	Remarks
	Width	Height					

Figure 15. The Schedule title and column headers.

Testing the Schedule

First, create two or three door styles and attach the “AU-DoorStyles” property set definition to them (don’t fill in any of the values. Once that’s been done, insert several doors into the drawing using those styles. If the schedule doesn’t update automatically, add the doors to it by selecting the schedule, right-clicking and selecting “Selection”, then “Add”. Select all of the doors. Your schedule should look similar to Figure 16.

Note that the values for the fields “Fire Rating” and “Material” are blank; if you wanted to edit the table cells there is nothing to select. You may want to revise the “AU-DoorStyles” property set definition to add “-” as a default value, as we did with the object-based property set.

Door Schedule							
Mark	Size		Material	Swing Direction	Hardware	Fire Rating	Remarks
	Width	Height					
?	2'-6"	7'-0"		LEFT	?		?
?	3'-0"	7'-0"		LEFT	?		?
?	PR 3'-0"	7'-0"		NA	?		?
?	PR 2'-3"	7'-0"		NA	?		?
?	PR 2'-6"	7'-0"		NA	?		?
?	3'-0"	7'-0"		LEFT	?		?

Figure 16. The Door Schedule with Doors attached. Some Property Sets are not attached to the doors, indicated by the question marks.

Next, add the object-based property set definition by selecting the schedule and using the “Add All Property Sets” command from the right-click menu. All of the question marks should now be gone and replaced with values.

Classifications

Classifications are a way of further categorizing AutoCAD Architecture objects. They can also assist you with controlling schedule objects by allowing you to determine, in the case of doors, for example, what types of doors might be included in the schedule. When you place restroom layouts in the drawing, you need some way of making sure that the partition doors don't get accidentally included with your schedule. Another example is doors to be demolished, or existing doors.

The first step in working with classifications is to create a classification definition, which can include any number of classifications for any number of object types. There is an example of a classification definition included with the AutoCAD Architecture sample styles that uses the Unifomat II system to classify objects. For our example, we'll create an extremely simple classification definition for doors, then assign it to the door styles we have already created.

First, create a new door style and call it “Demolition”. Add these doors to the schedule and use the “Add All Property Sets” command to activate their property data. (In this example we're forcing them to be in the schedule to illustrate the functionality of classifications. Once we're done, it will be impossible for the demolition style doors to be included).

- **Classification Definitions** – Activate Style Manager and go to the “Multi-Purpose Objects” category. Under “Classification Definitions” create a new definition called “DoorTypes” and edit it. Under the “Applies to” tab select “Door Styles” only. (Note: The Unifomat II classification definition applies to all object types). Under the “Classifications” type, use the “Add” button to add three classifications: “Demolition”, “Toilet Partitions” and “New Construction”. Select “OK” until you return to the drawing editor.
- **Restricting the Schedule** – Select the door schedule that you created earlier, right-click and select “Edit Schedule Table Style”. In the “Applies to” tab, you should now have the “DoorTypes” classification available in the window on the right (see Figure 17). If you don't, check the classification definition again and make sure that you checked on “DoorStyles” in the “Applies to” tab. When you select the “+” sign to the left of the “DoorTypes” label, it will expand out to reveal

the three classifications that you defined. Place a check mark for “New Construction” only, and select “OK” until you return to the drawing editor. Your schedule should once again be empty. You have now specified that not only does it just apply to doors, but only to doors classified as new construction.



Figure 17. Restricting the Schedule using Classifications.

- Assign the classifications to the doors** – While classifications can now be assigned to individual objects, it is usually best to assign them to the styles themselves using the ability to assign individual objects a classification to override a style setting if necessary. Select one of the first doors that you placed in the drawing, right-click and select “Edit Door Style”. On the “Classifications” tab, select “New Construction”. Do the same to the second group of doors that you placed. Finally select one of the last doors that you placed and set the classification for that style to “Demolition”. Finally, add the doors to the schedule again. Note that this time, even if you select every single door in the drawing, only those doors on a style that is classified as “New Construction” is included in the schedule.

Advanced Properties

In addition to the user-defined properties and basic automatic properties that we’ve already experimented with, there are additional, more advanced automatic properties that you can use to further refine the scheduling in AutoCAD Architecture and AutoCAD MEP.

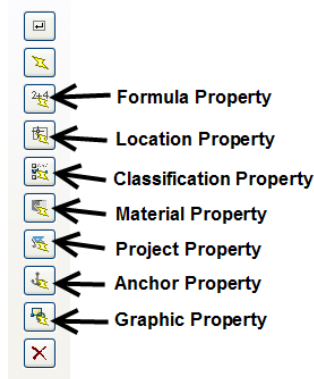


Figure 18. Advanced Automatic Properties.

- Formula Properties** allow you to concatenate two or more other properties, or to perform math on properties to arrive at a new value. An example of this is the door schedule that is provided with AutoCAD Architecture, which uses the room number and a door suffix to generate a composite door number

- **Location Properties** allow for objects to be reported by their physical location within a model. Again, the stock door schedule's door number value is generated by using a location property assigned to the doors to assign a room number.
- **Classification Properties** allow you to include the classification of an object (or a property attached to a classification) in the schedule itself.
- **Material Property:** When you assign a material to an object, you can have that material reported directly in the object's schedule. In our example, we'll assign materials to components in our door styles, then replace the user-defined "Material" property with an automatic material property definition. Materials can have their own property sets assigned, and those properties can be propagated to our object's schedule. We'll see how this works first-hand.
- **Project Property:** If you are using the Drawing/Project Management features of AutoCAD Architecture or AutoCAD MEP, you can have any of the data associated with your project, including level and division information, reflected in the schedule. The room numbers that AutoCAD Architecture's stock room tag generates is based on the "Level" project property.
- **Anchor Property:** If an object is anchored to another object, properties of the host object can be extracted and used in the property sets of the anchored object. For example, you can extract the Fire Rating property of a wall and assign it as the Fire Rating property of a door that is anchored to the wall. Changing the fire rating of the wall will also change the fire rating of the door.
- **Graphic Property:** You can associate a block definition or an image as a property of an object, to allow that graphic to display in a schedule.

Using Material Properties

We'll take a look at the more complex project-based door number property in a bit, but first let's take a look at material properties. First, use Style Manager to import the following materials into your current drawing from the "Material Definitions.dwg" file that is included with your AutoCAD Architecture / AutoCAD MEP sample styles:

- Doors & Windows.Wood Doors.Ash
- Doors & Windows.Metal Doors & Frames.Steel Doors.Painted.White

Next, assign the "Ash" material to all of the components of one of your "New Construction" door styles except for the glass. Do the same to the other "New Construction" door type, using the "Painted.White" material.

- **Edit the Property Set Definition** – Edit the "AU-DoorStyles" property set definition and add a Material Property. In the Material Property Definition screen, change the name to "MaterialDefinition" and expand the "Door Style" tree. Select "Panel" to use the material assigned to the door panel for this value. Select "OK", then set the data format type to "Case – Upper". Finally, select "OK" until you return to the drawing editor. (See Figure 19).

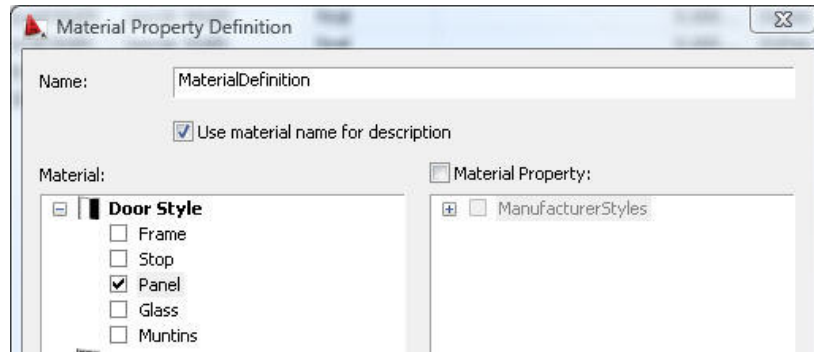


Figure 19. Creating a Material Property to store the Material Definition assigned to a Door Panel.

- **Edit the Door Schedule Style** – Select the door schedule, right click and select “Edit Schedule Table Style”. On the “Columns” tab, select the “Material” column and delete it. Next, add a new column and use your new “MaterialDefinition” property. Change the heading to “Material” and at the bottom left of the “Add Column” dialog, change the “Column Position” settings to “Insert Before” the column “AU-DoorStyles:DoorSwing”. Select “OK” until you return to the drawing editor.

Your schedule should now report the materials that are actually assigned to the door panels, however the full material name is being reported, which is probably not what you would want in this case. To refine this, we’ll create a new property set that will be assigned to the material definitions themselves. The property set will include a “MaterialCode” property that will shorten the material definition, and we’ll call for this value to be reported in our door schedule.

- **Create the Material Property Set** – Using the techniques that we used to create the property sets for doors, we’ll create one for our materials:
 - Create a new property set, called “MaterialDefinitions”.
 - In the “Applies to” tab, select “Styles and Definitions”, then clear all entries except for “Material Definition”
 - In the “Definitions” tab, add a new user-defined property definition, called “MaterialCode”. Make its format “Case – Upper”.
 - Save the property set definition, then edit the “AU-DoorStyles” property set definition.
 - In the “Definitions” tab, select the “MaterialDefinition” property that you defined earlier and select “Edit Material...”
 - Now that there is a property set definition assigned to material definitions the “Material Property” option is available. Place a check mark in that box, and select the “MaterialCode” property, as shown in Figure 20. This will cause the property attached to the material definition to be reflected in the door schedule whenever that material is assigned to an object in the schedule.

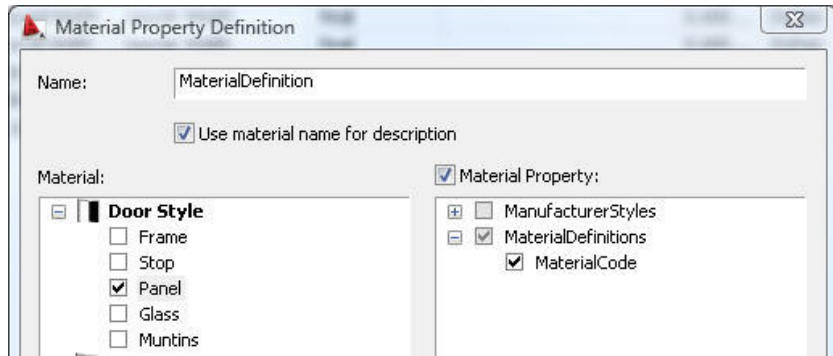


Figure 20. Linking the Material Property to the Material Code property of the Material Definition itself.

- Before the material property can be used, it has to be assigned to the material definitions themselves. While you are still in the Style Manager, edit the “Doors & Windows.Wood Doors.Ash” and “Doors & Windows.Metal Doors & Frames.Steel Doors.Painted.White” materials, attaching the “MaterialDefinitions” property set definition to them. Assign a value of “WOOD-ASH” and “STEEL-PAINTED” to them, respectively, then select “OK” until you are returned to the drawing editor.
- Update the schedule. It should look like Figure 21.

Door Schedule							
Mark	Size		Material	Swing Direction	Hardware	Fire Rating	Remarks
	Width	Height					
01	2'-6"	7'-0"	WOOD-ASH	LEFT	---		---
02	3'-0"	7'-0"	WOOD-ASH	LEFT	---		---
03	PR 3'-0"	7'-0"	STEEL-PAINTED	NA	---		---
04	PR 2'-3"	7'-0"	STEEL-PAINTED	NA	---		---
05	PR 2'-6"	7'-0"	STEEL-PAINTED	NA	---		---
06	3'-0"	7'-0"	WOOD-ASH	LEFT	---		---

Figure 21. The updated Door Schedule with the Material Codes displayed.

So, what just happened? To review, we can assign a material property, which at its most basic level, can simply report back the name of the material assigned to a component. In our example, the material definition name was too long, and not appropriate for the schedule, so we created a new property set definition, attached to the material definition itself. Using that property set definition, we are able to actually report a property of the material itself (in this case a shortened material name, or “code”) in the door schedule. See Figure 22.

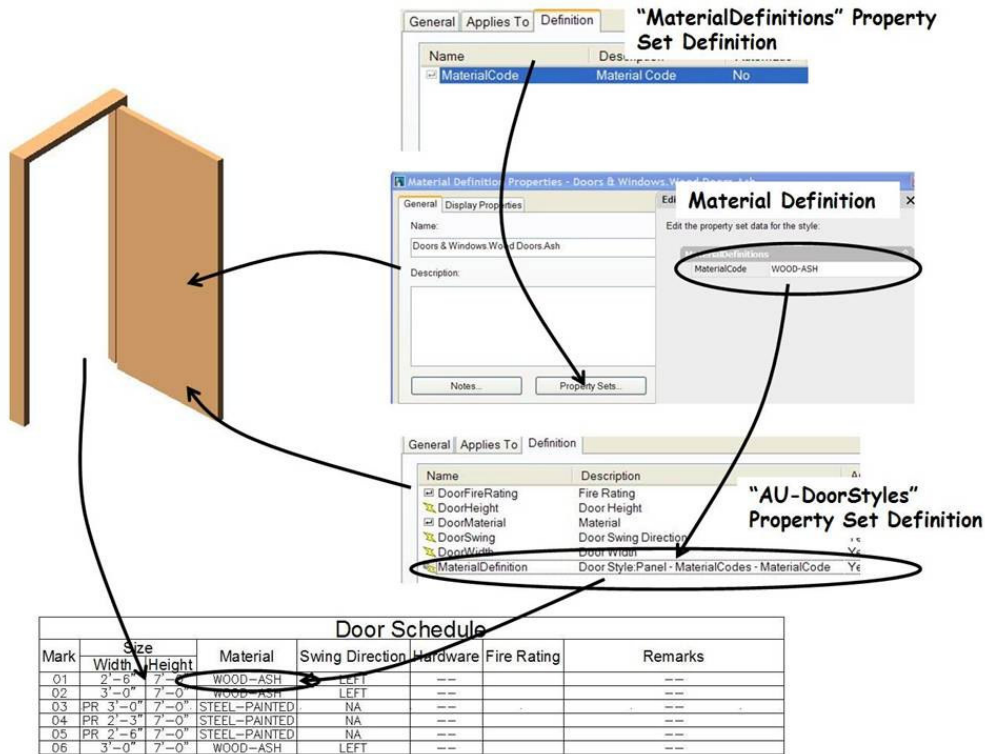


Figure 22. The relationship between the door, the Material and Material Code Properties.

Project, Location and Formula Properties

An excellent example of these three advanced property types working in concert can be found in the “stock” door schedule and “Project-Based” door tag that comes with AutoCAD Architecture and AutoCAD MEP. Rather than re-invent the wheel, we’ll reverse-engineer this existing content.

The end result of what we are about to look at is a door number property that is “intelligent” enough to not only “know” what room the door belongs to, but what level it is on. To see how it works, you’ll need to set up a project using the AutoCAD Architecture Project/Drawing management tools. Create at least two levels, and draw a simple floor plan construct on the 2nd floor of your project. *(Note: Drawing and Project management are outside the scope of this tutorial; if you are not familiar with the terms or procedures mentioned here, you may want to research this feature a bit more – the particular functionality being described here is dependent upon the project management capability of AutoCAD Architecture).* In your floorplan, use some of the pre-defined “stock” doors from the “Doors” tab in AutoCAD Architecture. Don’t use any of the doors we defined earlier or the basic “Standard” door style.

Examining the Room Number

As stated previously, the doors that we are using “know” which room they are in. We’ll see how that happens in a bit, but how is the room number itself generated? To see how this works, you’ll need to create spaces (these are required in order to have a “Room Number” property to assign to them). Use the “Space Auto-Generate Tool” from the “Design” tool palette to quickly create space objects inside your rooms.

Once you've generated the spaces, attach the appropriate property set definitions by tagging them with the "Room Tag – Project Based" tag from the "Annotation" tool palette, then select one of the rooms and examine its properties on the "Extended Data" tab of the properties palette (see Figure 23).

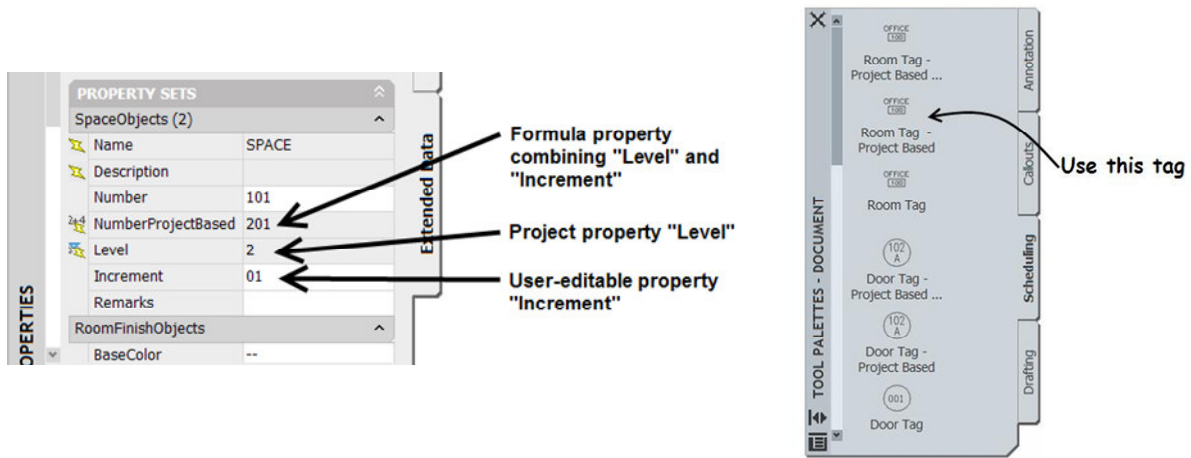


Figure 23. Using the Project Based Room Tag to reflect the Project Based Room Number Property.

Note that the "NumberProjectBased" property, which is what we'll be using for the room number (and which is what the room tag is showing as the room number) is not editable. It is a formula property that combines from two other properties. First, the "Level" property is a project property that reads the value for the level of the drawing in which the room exists. The "Increment" value is user-editable, and an auto-incrementing numeric value. These two values are combined in a formula to form the complete room number. (To see how a formula property is formatted, you can edit the "SpaceObjects" property set definition and look at the "NumberProjectBased" property).

Generating Door Numbers

With the spaces tagged so that they now have a project-based room number assigned, you can use the project-based door tag to build a door number based on the room number. From the "Annotation" tool palette, use the "Door Tag – Project Based" tool to tag all of the doors in the drawing. As before, select one of the doors and view its "Extended Data" properties (see Figure 24).

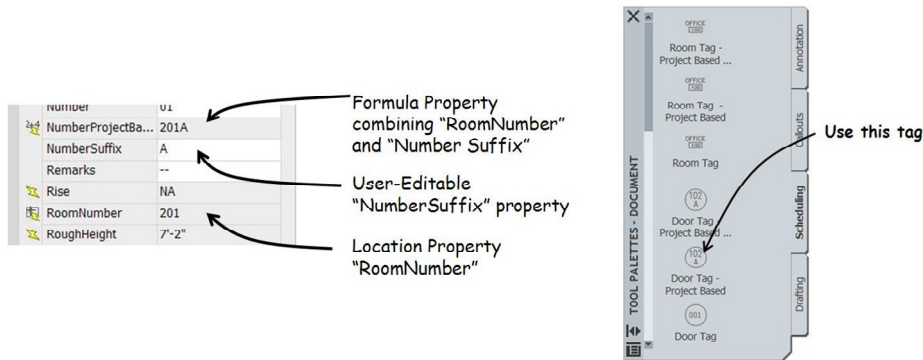


Figure 24. Using the Project Based Door Number tag to display the Project Based Door Number property.

Note here that first, there is a location property that extracts the room number that was assigned with the “RoomObjects” tag. We’ll look a bit more at this property in just a bit. Once the room number property has been obtained, it is combined in another formula property with the editable “Suffix” property. The end-result is a door number that reflects the room number, with the ability to change only the letter suffix directly.

Location Properties

So, how does the door “know” which room it is in? First, take a look at the “DoorObjects” property set and in particular the “RoomNumber” property. With the “RoomNumber” property selected in the property set definition editor, select “Edit Location”. Note that in order for a location property to be possible, there must already be Spaces present in the drawing, since a location property requires them. In this example, we are using the “NumberProjectBased” property in the “SpaceObjects” property set that was attached to our Spaces earlier as the source for our location property for the door number (see Figure 25).

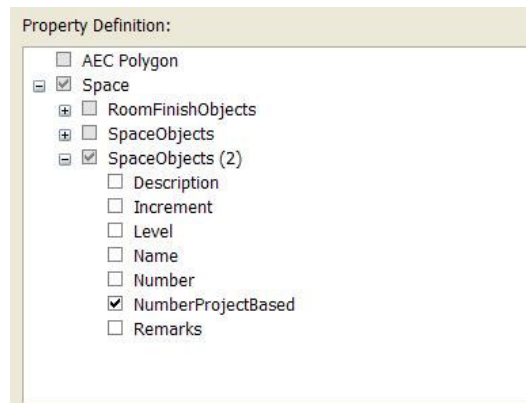


Figure 25. Examine the “SpaceObjects” Property Set that is used by the Door’s Location Property.

Exit the property set definition editor and return to the drawing editor without making any changes. ZOOM in on one of the tagged doors and select it. You should notice an extra grip, shaped like a star. This is the “Location Grip”, and the position of this grip is what determines which room the door “belongs” to (see Figure 26). Select the grip and move it to another room. Note what happens to the door tag.

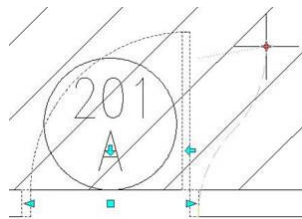


Figure 26. The Door Location Grip.

To illustrate further this “Location” and “Project Property” concept, save the drawing you’re in, then using the Project Navigator, select it, right-click and select “Copy Construct to Levels...”. Copy it to another level (rename the copy if you like), then open the copy. You should notice that the room numbers immediately update to reflect the new level assignment, and immediately after that the door numbers will update to reflect their new room assignments.

Tagging and Scheduling in a Project Context

When working with a project in which you are taking advantage of AutoCAD Architecture and AutoCAD MEP's drawing and project management capabilities, you will also be working in an environment that utilizes external references extensively. It is important to remember that objects in the schedule do not have to exist in the same drawing as the schedule. Schedules will read objects that are nested in external references; in fact, you can create a schedule that tracks objects in a drawing that is not even referenced into the schedule drawing. When you place the schedule in a sheet (drawing), rather than select objects as we did in the previous exercises, simply press <ENTER> and place the empty schedule in your drawing. Next, select the schedule and in the properties screen, set the value for "Schedule External Drawing" to "Yes", then browse and select the drawing to schedule (see Figure 27).

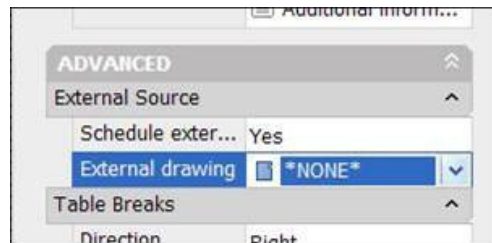


Figure 27. Configuring a Schedule Table to read an external drawing.

Some things to remember about scheduling external references and external drawings:

- "Automatic Update" and "Add New Objects Automatically" are irrelevant in drawings where a schedule is reporting an external reference. New objects are added automatically as a rule whenever a reference file is updated and the schedule is updated with the right-click "Update Schedule" command.
- "Automatic Update" and "Add New Objects Automatically" are disabled for schedules that are reporting an external drawing source. When the drawing containing the schedule is opened, the schedule will update automatically after scanning the external drawing source. (The right-click "Update Schedule" command can also be used to re-scan the external drawing source).
- In the case of both externally referenced drawings and external drawing sources, since new objects are added automatically, there are two ways to prevent objects from being included in the schedule. Classifications can be used to filter objects; failing that, layer wildcards can be used to only include objects that are on a particular layer. Layer wildcards are set in the properties screen for the schedule.
- Object tags do not have to exist in the same drawing as the objects themselves. You can tag objects that reside in external references.

Creating Custom Object Tags

In addition to creating your own schedules and property set definitions, you also have the tools at your disposal to create your own object tags to go with them. The process for doing this has been greatly simplified in AutoCAD Architecture and AutoCAD MEP:

- 1) Create your property set definition and schedule. Make sure they are saved in a central library drawing so that the schedule can be created easily from a palette-based catalog. *Because of the nature of the functionality of the new schedule tags, I recommend that you store the property set and the schedules in the same drawing. I usually have a single file that I use to store all custom schedules and property sets.*

- 2) In the schedule/property set library drawing, create the graphics that will define your tag. Do NOT define blocks or block attributes! Simply draw the tag graphics and use MTEXT (not DTEXT) for any labels or text that you want in the tag. Make sure that you keep in mind the annotation scale factor in the drawing setup dialog box when sizing your tag objects.
- 3) Use the “Define Schedule Tag” tool from the “Format” pull-down menu:
 - a. Select “Define Schedule Tag” from the “Format” pull-down menu.
 - b. Select all of the objects (graphics and text) that will make up your tag.
 - c. In the dialog box, provide a name for your new tag. Each text object that you selected will be shown in the column on the left. For each text object, indicate in the next column to the right whether it will be a text element (not linked to a property) or a Property label. In the next column to the right, indicate which property set each property label will link to, and finally in the far right column indicate which specific properties each label will reflect. Figure 27 shows an example.

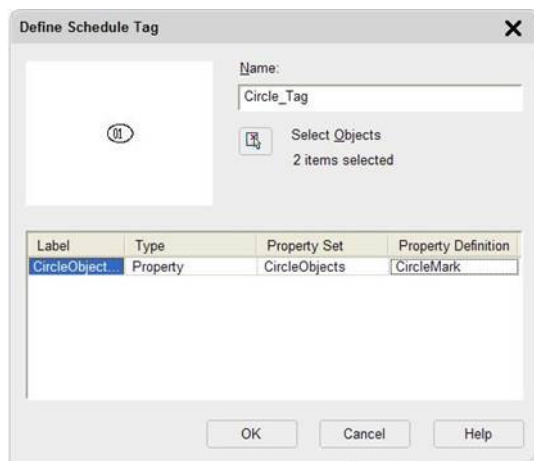


Figure 28. The Define Schedule Tag dialog box.

- d. After selecting “OK” in the dialog box, you will need to specify the insertion point for the tag. At this point, the command will do several things that used to have to be done manually (in other words, you don’t have to do this):
- e. It will create a block, turning the text that you specified into block attributes with the correct formatting that is needed to ensure that they are linked properly to the properties that you specified.
- f. It will create an MV Block out of the block definition.
- g. It will attach some kind of voo-doo that will instruct the MV Block to act as a schedule tag when used from the tool palette.
- h. Save the drawing (this is important – if you don’t do this before the following steps it will not work!).
- i. Drag the tag from the drawing window to an editable tool palette (as you would any other AutoCAD object from which you would want to make a tool).

- j. Modify the properties of the new tool by right-clicking on it and selecting “Properties”. Most likely the only thing you will need to do is specify the layer key to use when the tool is created.
- k. Test the tag in a brand new drawing to ensure that it is finding property sets correctly.
- l. Copy the tool from the palette to your custom tool catalog.

Fine-Tuning Properties and Schedules

When editing your property set definitions, you may have noticed three additional columns “Units”, “Visible” and “Order”. Each of these allow you to modify the way the properties are displayed or whether they are even seen or not:

- **Units** – Allows you to change the way a property is displayed after you have assigned a data format style to it. This only affects manual properties that are Real Numbers.
- **Visible** – By removing the checkbox for this value for a property, you prevent that property from appearing in the “Extended Data” tab of the Properties Manager. This is handy for properties that are not in and of themselves editable and that may not be directly used in a schedule, and therefore would be superfluous as a visible property in most cases (for example, the “RoomNumber” property for a door number).
- **Order** – By assigning a display order to visible properties, you can control the order of their display in the Properties Manager, making those that would be most often edited display at the top, for example.

You can also use **List Definitions** to control the values for a manual property. First, create a List Definition (under “Miscellaneous Objects” in Style Manager) and specify that it is to be used for Manual Properties. When you define your Manual Property, set the Type value to “List”, then specify the List Definition that you want to use. (Note: there is an option when defining the List Definition to allow values other than those in the list to be typed in by the user).