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Finding Your Way Around Autodesk® Architectural Desktop Areas

David Driver

BD42-2 Area and Area Groups are powerful functions of Autodesk® Architectural Desktop. This class will cover these features in depth, from how to add them in your designs to creating both schedules and evaluations that satisfy BOMA requirements.

About the Speaker:

David Driver is a registered architect living in Tucson Arizona. Having worked in architectural firms since 1984, Driver has held positions of architect, project manager and computer manager. In addition to on-going production work, Driver provides consulting regarding CAD standards and implementation of Autodesk Building Design products and is co-Author of: Designing Mechanical Systems with Autodesk Building Systems released in the spring of 2003 by Autodesk Press, and contributing editor for the CDV Revit Courseware series. Contact: david@daviddriver.com

Way Finding within Areas:

Areas and Area Groups are a very useful tool in the Architectural Desktop toolkit. However, because there are so many parts and pieces involved, it is easy to get lost. This class is designed to help you find your way through the maze of related parts of the Area Evaluation to help make the most of this fine tool.

Systems Thinking:

Any time I have a new piece of software that I try to understand, I first attempt to apply systems thinking to the objects involved. Systems-thinking involves breaking down the components into a Kit of Parts and a Set of Rules. Areas and Area Groups are no exception, and fit into this thinking very well. The organization of this class follows this system based thinking.

Kit of Parts:

Areas
Area Groups
Calculation Modifier Styles
Group Templates
Name Definitions
Property Data Formats
Area Evaluations
Area Schedules and Tags

Set of Rules

Add Areas to the drawing
Use Name Definitions for consistent naming of areas
Add Area Groups
Use Group Templates for consistency
Apply Calculation Modifiers as needed to Areas and/or Groups
Attach the Areas and Area Groups together in logical order
Create Area Evaluations and/or Schedules

Area Evaluations Kit of Parts:

The Kit of Parts for the Area Evaluation consists of two drawing objects, four style based tools or modifiers and two different ways to query the information held by the areas:

Drawing Objects	Style Tools	Query Tools
Area	Calculation Modifiers	Area Evaluation
Area Group	Group Templates	Schedules
	Name Definitions	
	Property Data Formats	

Areas

The Area object is the foundation of the area evaluation. This is the object that holds the area and perimeter reported in the evaluation.

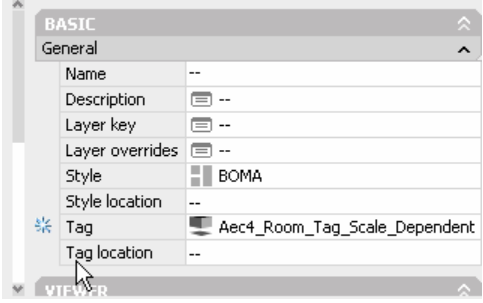
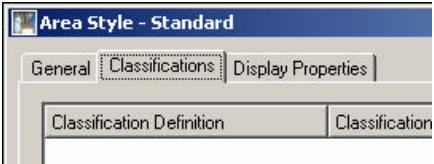
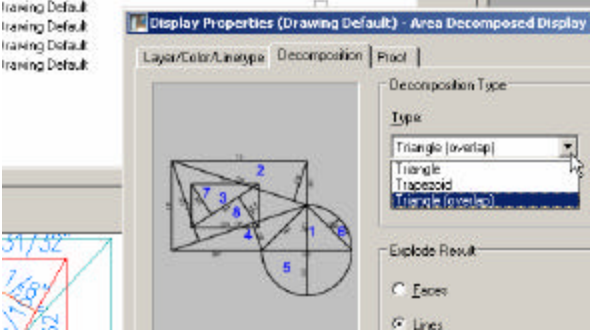

Areas can either be additive or subtractive, or combinations thereof.

Basics



Properties:

The properties of an area contain the standard AEC object information such as the Name, the description, layer and style. Particular to the Area are the ability to assign a Calculation Modifier to the area, or assign the area to a specific area group.

	<p>Palette Tool Properties:</p> <p>The palette tool provided for Areas hold just the same information as the ACAD properties page, but allows you to set layer key, or overrides as well as set an external location for a tag that will be added with the area</p>
	<p>Area Styles:</p> <p>Unlike most ADT object the area style is minimal, containing only the General, Classifications and Display Properties tab. I find it useful to have a couple different styles handy in the templates to control hatching.</p>
<p>Display:</p> <p>More is told about the Area object by looking at it's display properties:</p> <p>There are two main display representations for the area object, the Decomposed Representation and the Plan Representation.</p>	
	<p>The Decomposed representation displays on screen the method for calculating the area. This representation is useful for back-checking area calculations and is required in some regions to be submitted as proofs for building permitting purposes.</p>
	<p>The Plan representation is used in one way or another for the remainder of the representations for the Area object. The plan rep allows you to control the hatching and color of the boundary differently.</p>

Adding

There are many different methods for adding areas to the drawing. This drawing I started with the standard template of the project and then just inserted a drawing whose content was only the style for the Areas and Area Groups I needed. This is the Area & Area Group Styles - BOMA (Imperial).dwg.

Pick points

You can simply pick points as you would a polyline – useful for sketching areas over the top of site plans, vanilla AutoCAD plans or images.

Tool, RightClick > Apply to:

As with other ADT objects you have several more ways of adding areas if you right click on the Area tool and select Apply To...With the Area object you have three choices in the apply to flyout and each gives a slightly different set of subcommands. You can apply the area tool to Areas, Linework and AEC Objects or Auto-Detection.

Apply to:Areas

When you apply tool to areas, it just takes what ever setting are in the tool properties (not the ACAD properties) and applies them to the existing area(s) you choose in the drawing.

Apply to: Linework and AEC Objects

is for polylines and space objects. You can use any other AEC objects, such as a roof, to get the space of a dormered area at any given height, but in general, I find the space object may already exist, and if I want the functionality of the areas, it is just a few steps away. This is NOT the command to use on walls, that command is..

Apply to: Auto-Detection

When you use this command it will ask at the command prompt to: Select bounding objects that will form the boundary of the areas: just cross across the plan and you are set to go. You may want to remove things like toilet partitions, and cabinetry that are wall styles before you end the selection set.

Tool, RightClick > Style

Just opens up the style manager filtered to the styles available in the drawing.

Some tips:

You can get polylines by changing to the reflected display configuration, setting the cut plane above the windows and doors, turning of the ceiling layer if there are ceiling grids and then using the BPOLY command to pick the rooms in the plan.

If your walls are center justified you can use the diagnostic configuration to snap to the graph lines of the walls.

Other

Project Navigator

While I want this to do is exist as a View because it is 2D information – however the project based tags will not work unless it is an element. More on this later.

Modifying

ACAD Modifying

Copy, cut, paste functions all work fine. However if you need to cut one do not use the standard ACAD trim command, use the trim or divide off the right click menu instead.

Grips.

Standard grip stretch functions apply – no special grip stretch like slabs or stairs. If you need more points, use the Right Click > Edit Vertices and watch the command line for *Pick vertex to add or shift-select to remove:* to allow you to add or remove vertex points.

RightClick Tools

<div> <div>Operation</div> <div> <div>Edit Rings</div> <div>Edit Vertices</div> <div>Attach to Group</div> <div>Detach from Group</div> </div> </div>	<div> <div>Join</div> <div>Subtract</div> <div>Intersect</div> <div>Trim</div> <div>Divide</div> </div>	<p>Once the basic areas exist in the drawing you will use the right click menu commands to modify them.</p> <p>Join will make two separate areas report as one value – even if they are not touching.</p> <p>Subtract will make a subtractive area inside the selected area. The subtracted area will be taken away from the area.</p>
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Etcetera

With 2004, you can use areas instead of spaces to establish the rooms for the building – meaning you can tag areas with installed room tag and project based room tag. However other functions of the space object are not fulfilled by the area. These include the ability to crop a ceiling grid and to pass the room number on to a door.

Ceiling Grids

If you want to use the area objects as the boundaries for a ceiling grid, Right Click and Generate a Polyline from the area, and then use the polyline to clip the ceiling grid.

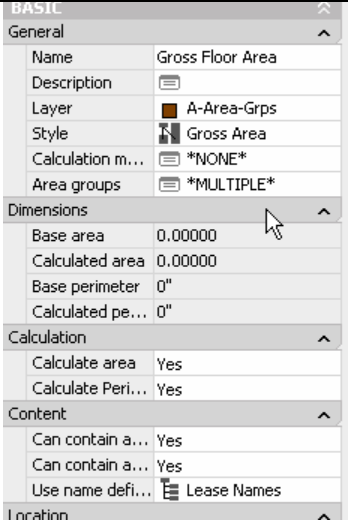
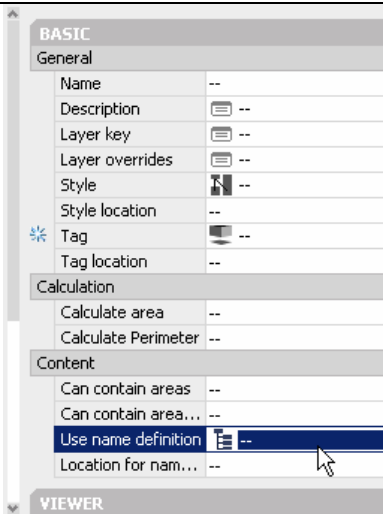
Project Based Door Tags. While not set up with the installed content (property sets and tags) you can with a simple tweak adjust the provided tag to read room number value from the area and pass it on to the door tag

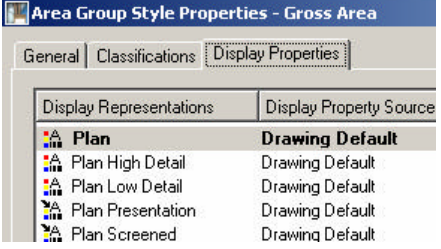
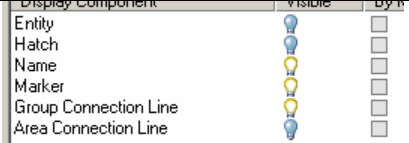
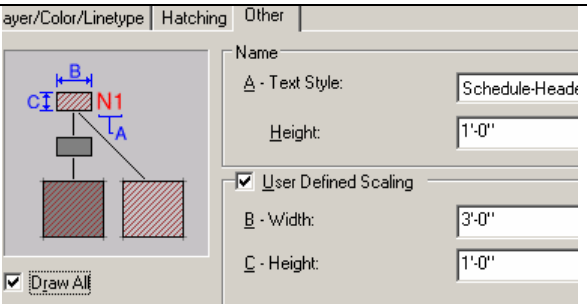
Area Groups

Area Groups are the way to collect areas together to sort and organize the areas in the building. If you are using the Evaluations, you can then pick and choose which area groups to include or not include.

Groups styles can be defined to be able to include other groups.

Basics

	<p>Properties:</p> <p>The Properties of the group are not that different than those of the Area.</p> <p>Of note is the Use Name Definition. This lets you assign a name definition for all areas in the group. A Name definition is just a list of names. This is handy if you have clients or building departments that want a consistent naming convention and a storage are is not Storage on one plan, Closet on another and Unoccupied on a third.</p>
	<p>Palette Tool Properties</p> <p>The Area Group Tools are again not that different from the Area Tools, but you can assign a name definition to the Area Group as it is created. That is enough reason to perhaps copy this tool on the palette.</p> <p>You can also tag groups if you want to, I have not found any reason to create one but I guess</p>

	<p>Area Group Styles:</p> <p>Also like Areas, there is not much in the group style other than classification and display control</p>
<p>Display:</p> <p>There is more in the Area Group Display than anywhere else. Again, mostly in the plan display. The default settings are fine for most things, but you should understand what the subcomponents are.</p>	
	<p>Plan Representation</p> <p>Entity is the small box along with a surrounding line on all areas that are assigned to the group.</p> <p>Hatch if it is turned on will hatch all areas assigned to the group – only if the “Entity” is turned on. Otherwise it will hatch only the small marker that is the handle of the group.</p> <p>The Area and Group Connection lines will just show a visible link between the attached parts and pieces.</p>
	<p>The Other tab of the plan display controls how the text appears next to the groups</p>

Adding

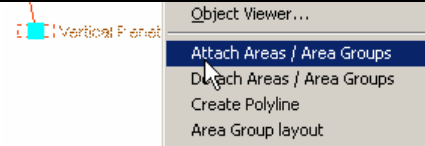
When you add a Group, you are only adding a marker. For those of you familiar with Mass Elements and Mass Groups, the idea is the same. An Area Group is nothing without something attached to it.

You can add entire hierarchies of groups at one time using the Area Group Templates – see below.

Modifying

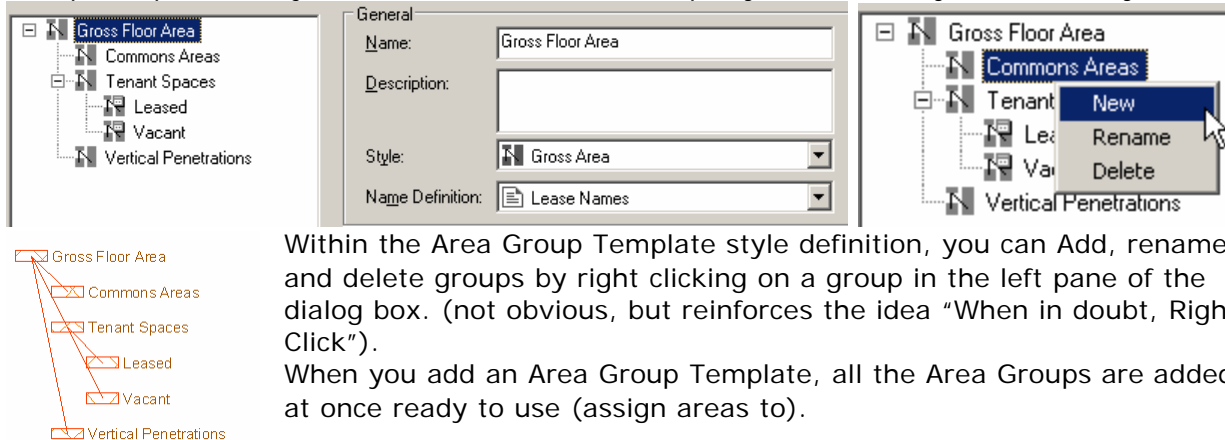
There is not much to do with ACAD to an Area Group except move, copy and paste and all these work fine.

RightClick Tools

	<p>Right click tools are pretty limited to attaching or detaching area and area groups from the selected group. The Area Group Layout will just modify the location of the group in the layout.</p>
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Area Group Templates.

Group Templates are just a collection of Area Group Styles stored in yet another style.

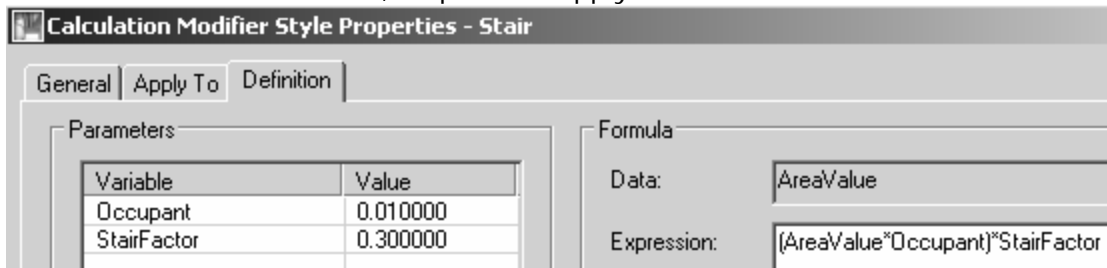


Within the Area Group Template style definition, you can Add, rename and delete groups by right clicking on a group in the left pane of the dialog box. (not obvious, but reinforces the idea "When in doubt, Right Click").

When you add an Area Group Template, all the Area Groups are added at once ready to use (assign areas to).

Calculation Modifier Styles

A Calculation Area Modifier is a mathematical expression you can assign to an Area or Group in its properties page. Assigning a calculation modifier will let you pull two values from the area. The Base area which is the sum of all the additions and subtractions of the area and the Calculated area which is the result of the function you have assigned via the Calculation Modifier style. When you create a Calculation Modifier style you can decide to apply this to the perimeter or the area of the object (area or area group) If you leave both of these selected, you will see the Data on the right just read Value. Normally you will be creating a modifier to one or the other, so pick the Apply To tab and set that first.



This is an example of a Calculation modifier you could apply to gross occupied area to get the value for the width of stairs. The function takes the base area (applies to area not perimeter) and then assumes an occupant load factor of 100 SF / occupant. The Rules:

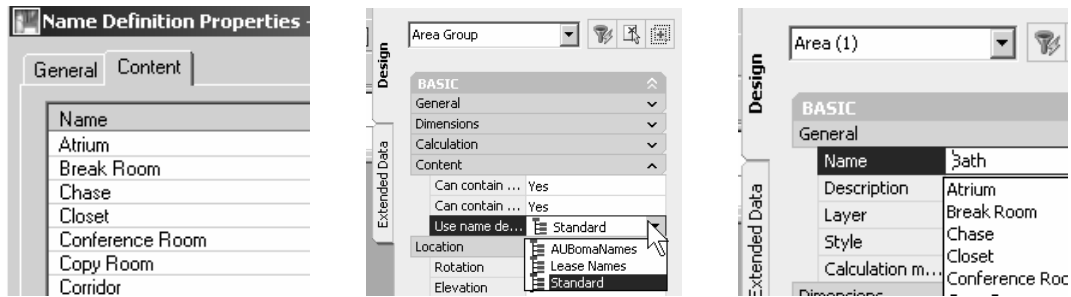
When you add a variable on the left, you can use it on the right. As you enter the value of the Variable on the right in the expression, this is CaSE sEnSiTiVe. Otherwise any expression you create will be applied to the area. Simple expressions using + - / and * are fine.

Odd:

You can only have one calculation modifier per area or area group. While at first limiting it is easy to copy areas and groups if you need more than one kind of modifier.

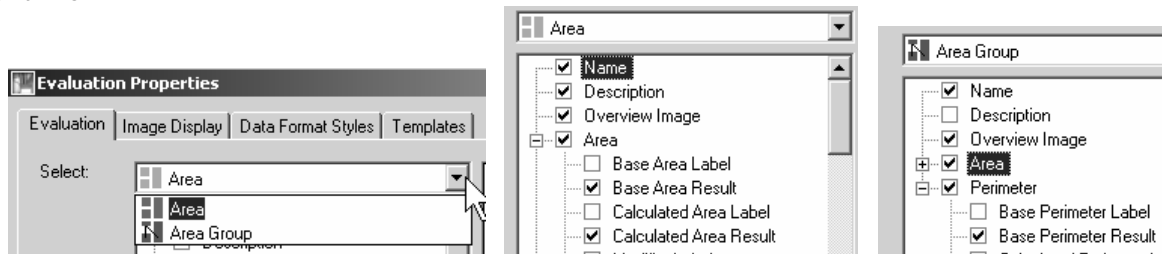
Name Definitions

A name definition is just a list of names that make naming the areas assigned to a particular group consistent. A name definition is assigned to an Area Group in the properties page. Once assigned, any areas that are attached to that group will have the drop down appear and list those names. This functionality will not prevent you from typing in a name that is not per the definition, but just provides the drop down that lets you use the list.



Area Evaluations

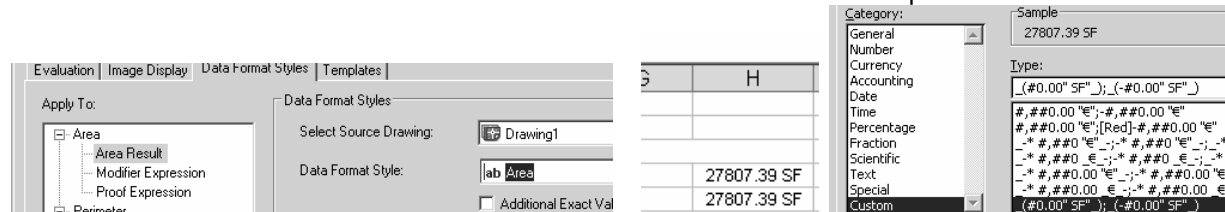
OK, all of that is fine, and all the parts have their place in creating the Area Evaluation. The Area Evaluation tool is on the same documentation palette as the area and area group tools. When you pick this tool, a new dialog box pops up that allows you to get visual feedback concerning the areas simply by selecting them on the left. Here you can isolate what areas and groups you want to write out to the excel sheet. The evaluation Options tab on the lower right controls how and exactly what the information will be written out to the excel or text file.



You control the Information for both Areas and Area Groups here, selecting if what parts you want to include in the evaluation: The Name, Description (from the Properties), A small bitmap image of the area or area group and what details about the Area or Perimeter to you want to push out to the excel sheet.

The Second tab just gives you control over how you want the images to be captured – you can set Display configurations that have solid shading so you see a solid image (use Presentation Configuration if you want this – already standard in the ADT templates).

The Third tab controls the format of the values written out to the spreadsheet



Here you assign a Property Data Format that controls how the value will be formatted in excel. While this is nice if the excel sheet is the end product, formatting cells beyond a simple number can be painful if you need to manipulate these values later.

The last tab is the template that will be used by the evaluation function. The templates for the evaluations are stored in a subfolder of the standard template folder.

C:\Documents and Settings\All Users\Application Data\Autodesk\Autodesk Building Systems 2004\R16.0\enu\Template\Evaluation Templates\... there are several for both text and excel format evaluation.

If you cannot access (it is grayed out) the evaluation export buttons at the lowest right, it is because you have not assigned a template yet. Pick the export button and voila!

Area Schedules and Tags

While the area evaluation is useful, there are times when you cannot get the base functionality to do everything you want to do, and other times when you want to keep the information in the drawing instead of an Excel sheet. In 2004 the schedule table got a very

thorough working over and you can now do quite a few things with the schedules that compliment the area and area group evaluation function.

Schedule Table				
Name	Project Level (B)	Base Area	Occ. Fact.	Occupants
Main Lobby	?	2025.27 SF	300	6.751
Corridor	?	1976.88 SF	300	6.59
Tenant Space	?	15568.02 SF	100	155.68
Tenant Space	?	3248.07 SF	100	32.481
Restroom	?	884.74 SF	300	2.949
Tenant Space	?	2546.99 SF	100	25.47
Stair	?	266.40 SF	1000000	0
Elevator	?	180.42 SF	1000000	0
Copy Room	?	199.95 SF	300	.666
Chase	?	109.51 SF	300	.365
Electrical Closet	?	324.36 SF	300	1.081
Stair	1	219.89 SF	1000000	0
Stair	?	256.90 SF	1000000	0
				232.034

This table shows how that you can do other things like establish your occupant load factor using areas

This table is set up like this:
There is a property set definition OccupantsStyleBased that looks like the image on the next page

Name	Description	Auto...	Type	De...	Format
BaseArea	Base Area	Yes	Auto...		Standard
OccupancyFactor	OccupancyFactor	No	Real	0....	Number - 0
OccupancyLoad	[BaseArea]/[OccupancyFactor]	Yes	Formula		Standard

I made this style based assuming I would create areas that were close enough to assign a variable OccupancyFactor and store that value in the style of the area. I made this just a manual property so that it can be manually set from style to style.

The BaseArea is just the area of the Area object. I did not use the one already provided because this value already has a property format of BOMA Area. This property format applies the NAU prefix and SF suffix to the number and I find that I like to keep numeric values straight forward in case I need to use the value in a Formula property (as I do here). applies to area styles that has two values in it.

The Formula is as per above assuming the base area will be divided by the occupancy factor.

Some notes on Property formulas:

You will get odd values in the schedule if the occupancy factor value is not set (or 0) once all the styles get assigned a numeric value for the OccupancyFactor things will be set fine. If you are doing complex formulas, you must use the buttons on the property creator, you cannot just type this in. I have found that this is very finicky and that sometimes it is easier to recreate an entire property rather than modifying an existing formula.

	Name	Project Level...	Base Area	Occ. Fact.	Occupants
Property Set	BOMA_AreaSt...	AreaObjects	OccupantsStyl...	OccupantsStyl...	OccupantsStyl...
Property	Name	Level	BaseArea	OccupancyFa...	OccupancyLo...
Format	Standard	Standard	Area	Standard	Standard
Example	0	0	SF	0	
Total	No	No	No	No	Yes
Hide	No	No	No	No	No
Matrix	No	No	No	No	No
Max Cols.					

This schedule definition looks like this. Even though I keep the raw data that exists in the property definition as a number, I have no hesitation to reformat that value in a column in a schedule. Here the OccupantsStyleBased:BaseArea –is Standard as set by the property, but overridden as an Area property format in the table that gives me the SF at the end of the value.

Other thoughts

The project based Room tags are already set up to use areas but the project based door tag is not. You can use areas instead of spaces as the basis for your door tags by making this small adjustment. Currently the door tag uses the DoorObjects Property set. If you add this tag to a door over an area you will get the space not found – even if the space already has a room tag on it.

Open up the style manager>Documentation Objects and then the property set DoorObjects. The door number is a formula **[RoomNumber][NumberSuffix]** looking at the RoomNumber propsetdef – it is a location property pointing to the space object>RoomObjects (propsetdef)>NumberProjectBased. You can point this to the same location on the area object INSTEAD – not in addition to – to do so would be getting two values that might not be the same, don't do it. Choose one or the other and stick with it.

Project navigator

Have a drawing with a couple displays ready – one that shows areas and the other that shows groups – make one layout that shows the areas in one viewport and the groups in another. Because the area and groups drawing will have special needs (display configs, schedule stuff) I make one area and groups template. You can always start with a template that is not part of the project and then save the drawing as a construct later. Again, personal preference, I like to keep the areas and groups in drawings separate than my main model files. This are not drawings I give to my consultants, and very seldom plot, so I assign them to a separate division that keeps them out of the main project path.

There are two ideas promoted by about how to use areas and area groups Top Down and Bottom Up. Top Down means you put the groups in the drawing first via a Group template. Assign Name Definitions to the area groups And then assign the group as you add the area (properties page) so you have access to the name definition list. While this allows you to take advantage of the Name definition list, I find this way annoying. I prefer to make all the areas I need and then assign them to groups as makes sense. I like this because when I am putting areas into the drawing, I find it easier to do If there are not a lot of other selections getting in the way of grip stretching. – yes I can get rid of the groups with display control, It is purely personal preference.

BOMA CALCS:

Before I say anything about BOMA Calcs – I must say get the publication. This is a legal document and any terms I use in this paper or in class, must default to the definitions outlined in the official BOMA document. Interestingly – you cannot download this from the BOMA site directly but must order it – but if you go to the ANSI site you can download it in PDF format. OK that disclaimer done...

I like to have one group template that has the following area groups in it.

Rentable, Usable and Building Common. You will need these areas of the building to create the BOMA calc and get the Rentable to Usable ratio, so it makes sense to me to have a group template already set up to show these values.

I also like to have my group styles hatched differently and hatch turned on so I can see what they are doing in the drawing readily

As much as I would like to have the schedule object do everything in the BOMA calc for me, I cannot see a way to have the schedules even with the formula based property set do the kind of calculations BOMA requires without doing a bit of VBA coding which I don't do. Basically what you need it to is look at all the subset of attached groups and select one and divide its area by another. (or in terms of scheduleing, take a value from one object and operate on that same value of another object.) Regardless, this is fairly painless to do in Excel if you watch your property Data Formats and are not sending a bunch of format code to the excel file. Set the Areas and Area Groups up in a way that makes sense and then use

the schedule function to push the data (Rentable, Usable and Building Common) for all floors of a building out into an excel file. Create a couple function cells and you are done.

Be creating in your use of objects when you are generating your areas – use the bottom view to get the sketch representation of the walls. Use the reflected display config and use Bpoly to generate polylines, adjust window and door/window assemblies to get a single line so you don't have to draw around all the windows.

You can find this handout and the class files on my website after Dec 17

Building Systems:

Use the Areas and Area groups on the 2D elevations to quickly find the area of wall/glazing.

Apply a calculation modifier to the floor area to give you rough energy calcs based on watts/sq ft.

www.daviddriver.com or if you have questions or comments, feel free to email me 4d@pobox.com

Remember to Think outside the box, and thanks for attending my class!!!

Property Definitions Addenda

The rest of this is a small section of a post from Scott Arvin. I cannot remember exactly when this was posted, but it was up on the ADT customer files newsgroup. I encourage anyone interested in pushing schedules to their limits to go out and find the full document – if you cannot find it, email me and I will track it down for you. I am putting this portion here because he has done a good job of explaining the formula property definition and you will probably find it useful!!!



Formula Property Definition

A Formula Property Definition was designed to perform computation on one or more property data values. For example, if you have automatic door Width and Height properties you can create a Perimeter property definition with the formula “2 * **[Width]** + 2 * **[Height]**”. See how formulas are used to number doors based on room numbers in the example at the end of the Project Property Definition section.

A formula is computed using VBScript, so all functions available in VBScript are available in a formula property definition. Basically you have a complete programming language available to massage your property data however you want. In the formula dialog you define a string that is the formula itself. Into this string you can insert references to other property definitions either within the same property set definition or from other property set definitions that might be on the object. The values of these other property definitions are inserted into the formula string, and then the string is evaluated with VBScript. The result of that evaluation is returned as the value of the formula property.

Formulas are going to be the most difficult property definition to work with, because for all but the simplest tasks of basic mathematics and concatenating strings together, programming is required. Let me say that again – *creating formulas is often programming!!* So they are not for the faint of heart, and will likely take some effort to make them work correctly. You're basically programming with values you can't easily predict, and without the aid of a development environment. Yes, this may be difficult to use at times, but it is incredibly flexible once you get the hang of it (as with many AutoCAD features) and was very easy to implement; the alternative was to not have the feature at all.

...[snip]... The Formula edit box contains the formula string itself. Below it are buttons used to paste common operations into the formula. The parenthesis and quotes buttons on the right end surround the current selection with parenthesis and quotes, respectively. All other buttons replace the current selection.

Property Definitions


The Property Definitions tree at the bottom contains all property definitions that can be applied to objects in the Applies To list of the property set definition containing the formula being edited.

Notes about property definitions in formulas:

If the property definition to be inserted in the formula comes from the same property set definition as the formula, only the property definition name is displayed, e.g.

"**[SwingDirection]**". Otherwise the property set definition name is displayed as well, e.g.

"**[DoorObjects:Area]**".

The red cross  means the property definition cannot be used in that formula, because:

- it is the formula being edited, as indicated by "[Self]" after its name. You can't have a value in the formula be the formula itself.
- it is a property definition that eventually refers to the formula being edited, as indicated by "[Circular]" after its name. Typically these are location or formula property definitions.

In order to use the value of a property definition in a formula you **must** select it from the tree, so that it displays as bold, e.g. **[SwingDirection]**, and in the Formula edit box you can only select the entire name and not just part of it. You cannot simply type the name of the property definition within brackets. If you do, it will display and behave as plain text like the rest of the formula. The reason for this is that a reference to the property definition is stored in the formula, not its name, so if you can change the name of the property definition the new name will be displayed in the formula. Another consequence of this is that when you copy and paste a formula string from one formula to another, you must reselect property definitions used in it.

Property Data Formats

Before the value of a property definition is inserted in the formula string, it is formatted with its property data format. If we didn't you couldn't get Door Size results like "3'-0" x 6'-8"", and instead would get results like "36 x 80". If you're going to do numerical calculations with a property that is normally formatted, then you should create another property definition that is unformatted. For example, create one automatic property called **[Width]** that uses an architectural format, and another called **[WidthUnformatted]** that is unformatted. Use **[WidthUnformatted]** in formulas, which then use the architectural format. This should be no big deal for automatic properties. To avoid having to duplicate manual property data, create an unformatted manual property to hold the actual data, and then create a formatted formula referencing the manual property.

Expressions vs. Functions

An *expression* is a simple single line statement using basic mathematical operations such as "+", "-", "*", and "/", or the string concatenation operator "&".

A *function* is a more complicated formula that uses multiple statements using VBScript syntax. If the formula contains the string "RESULT", in all caps, a function called RESULT is created and sent to VBScript for evaluation. For example, if this is the formula string:

```
If "[SwingDirection]" = "Right" Then
    RESULT = "R"
Else
    RESULT = "L"
End If
```

and the value of **[SwingDirection]** is "Left", then this is sent to VBScript for evaluation:

```
Function RESULT()
  If "Left" = "Right" Then
    RESULT = "R"
  Else
    RESULT = "L"
  End If
End Function
```

Visual Basic programmers will recognize that assigning a value to the name of the function is how you set the return value of the function.

How a Formula is evaluated

When the value of the formula property is needed, the process used to determine that value is:

1. For each property definition in the formula,
 - a. the value of the property using it is retrieved from the object or style,
 - b. it is formatted using the property data format defined for the property definition, and
 - c. the formatted value is inserted in the formula in place of the property definition name and its surrounding brackets.

Note: Make sure that all property sets used in the formula have been added to the object or style. Otherwise, "?"'s will be inserted instead.

2. If the formula string contains the word "RESULT", it is evaluated as a VBScript function.
3. If the formula string does not contain the word "RESULT", it is evaluated as a mathematical expression.
4. If VBScript doesn't know how to evaluate the resulting formula, the resulting formula becomes the value of the formula property definition. Depending on the formula, there will be times when it looks like the formula is 'exploded,' i.e. what is displayed is the formula instead of what you think should be the result of the formula. This is so you can 'debug' the problem formula and see what it will take to fix it. If this was not done, it would be difficult to see what might be wrong.

Strings

It is possible to concatenate two or more properties in a formula by simply putting them together, such as

[RoomNumber][RoomNumberSuffix].

But in some circumstances that might lead to unintended results, as described in the next section on numbers. If so, try using the string concatenation operator "&" and surrounding properties with quotes, such as

"[RoomNumber]" & "[RoomNumberSuffix]"

Imperial architectural formats are going to make things doubly difficult, because often you want to display them as strings, but they already contain both the single and double quotes. There is no clean way of dealing with these directly in a function. Try using unformatted values, as described above in Property Data Formats, and setting an appropriate format for the formula itself.

Remember

And just in case you missed the point earlier, **creating formulas is often programming!!**

☺ So don't be surprised if it takes a bit of work to get what you want!

Thanks to Scott Arvin!!!