

# Be Dynamic and Improve Your Efficiency with Dynamic Blocks in AutoCAD®

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**AC2470** If you find yourself constantly using a slight variation of one block or another, then this class is for you. Dynamic blocks can be a powerful and useful tool for creating reusable and changeable content for your drawings. You can customize them to contain a wide variety of options like sizes or opening angles and directions, which result in a very useful block that can be used in many ways in a drawing. In this class, you will learn how to create custom dynamic blocks with a variety of custom options and then use them in multiple types of drawings.

## Learning Objectives

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

- List the types of actions that can be added to custom dynamic blocks
- Create parameters and actions for dynamic blocks
- Edit and troubleshoot common block creation problems
- Add dynamic blocks to drawings and use the various options programmed into them to save time in creating designs

## About the Speaker

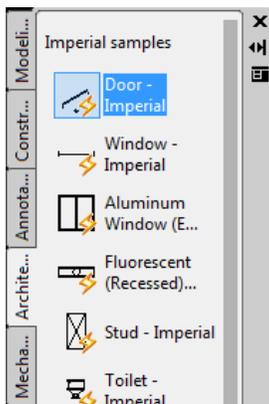
*Michelle started in the Air Force working in the Civil Engineering unit as a surveyor, designer, and construction manager. Her primary responsibility was to ensure proper grading of missile sites and tracking of base infrastructure. She has also worked for both municipalities and consulting engineering firms as an engineering/GIS technician. Michelle is highly regarded within the civil engineering industry; her comprehensive Autodesk Land Desktop and AutoCAD Civil 3D knowledge is supplemented with a strong understanding of other Autodesk technologies, document management, hardware, and networking. Her expertise has helped her clients maximize their project's effectiveness and ROI. She is an effective and skillful communicator, consulting with her clients to help achieve their business objectives. As a senior instructional designer for ASCENT, she has written books on AutoCAD, Map 3D, and Civil 3D and was the first Civil 3D Autodesk Certified Instructor and Evaluator worldwide.*

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## Introduction

### What is a Dynamic Block?

Dynamic blocks are powerful tools that allow you to use one block to represent multiple sizes, styles, and variations of an object or group of objects. A number of dynamic blocks are supplied with AutoCAD® and can be found on the Tool Palettes. To access the Tool Palettes, hold down <Ctrl> as you type the number 3. You can identify which blocks are dynamic by the lightning symbol over the block image. Using dynamic blocks can reduce the number of blocks in your block library.



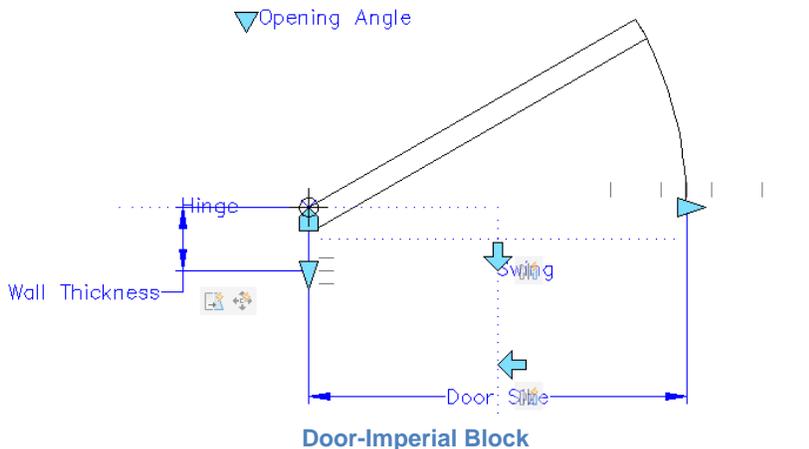
Tool Palettes

### List the types of actions that can be added to custom dynamic blocks

A number of actions can be added to a block to make it dynamic. Using the Door-Imperial block that comes with AutoCAD as an example, we see that one block can have multiple actions assigned to it. The image shows two stretch actions (to set the wall thickness and the door width), two flip actions (that determine the door swing), and a rotate action (that sets the opening angle of the door).

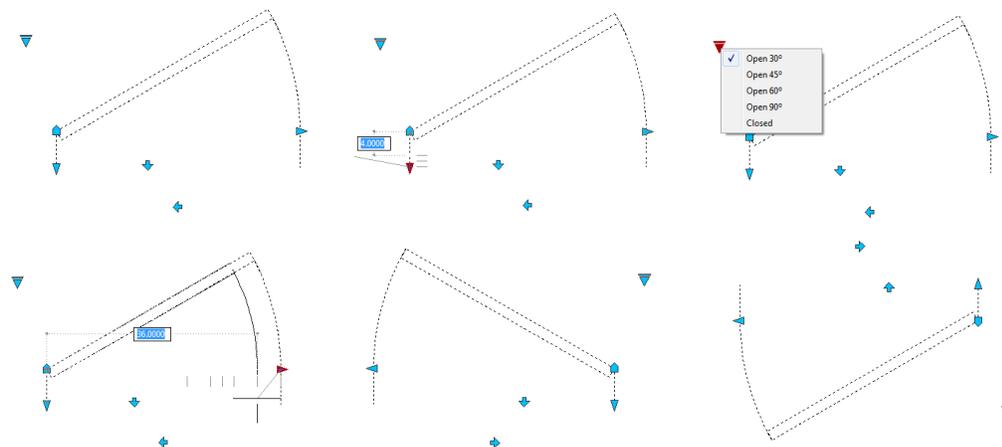
All available actions include:

1. Move
2. Scale
3. Stretch
4. Polar Stretch
5. Rotate
6. Flip
7. Array
8. Lookup
9. Block Properties



## Add dynamic blocks to drawings and use the various options programmed into them to save time in creating designs

Inserting dynamic blocks follows the same procedures used when inserting standard blocks. However, once inserted, selecting the block displays grips that can be used to edit the block. The images below show the grips for the Door-Imperial Block.



- Hover over a grip to display a tooltip that explains its use.
- Only blocks created with these features have this functionality.
- Some dynamic blocks are annotative and are automatically scaled according to the Annotation Scale set in the Status Bar.

### Typical Dynamic Block Grips

	Lengthen/Shorten	Enables you to scale, stretch, or array a block. The action depends on how the block was defined.
	List	Opens a list of options from which to select, such as size, number of items, view displayed, etc.
	Insert/Move	Indicates the insertion point of the block, as well as other points that might have been assigned in the block. It can move the entire block or just one entity within it.
	Flip	Flips the block or specific objects in the block in the direction of the arrow. Objects that flip are preset in the block definition.
	Align	Aligns the entire block at the angle of an object when you move the block near that object.
	Rotate	Enables you to rotate the block or specific objects in the block. Objects that rotate are preset in the block definition.

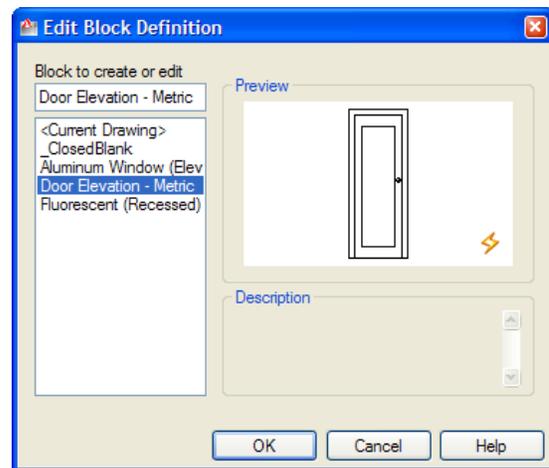
## Create Dynamic Blocks

### Create parameters and actions for dynamic blocks

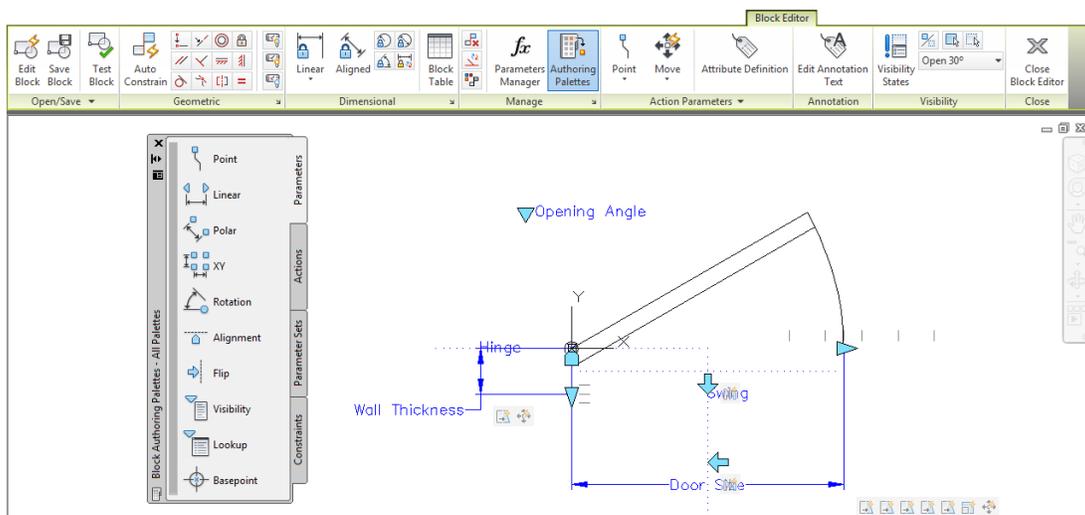
You can create new dynamic block definitions from scratch or modify an existing block to make it a dynamic block. Either way, dynamic blocks are created in the Block Editor. It is here that you add actions and parameters that turn a conventional block into a dynamic block. When you start the Block Editor from the Home tab>Block panel or double-click on an existing dynamic block, the Edit Block Definition dialog box opens. If you right-click on an existing dynamic block and select Block Editor, it opens the block directly in the Block Editor.

Hint: Locking the Block Editor

By default, in the AutoCAD software double-clicking on a block opens the Edit Block Definition dialog box. However, if you do not have experience creating dynamic blocks, or should not modify them, you might want to change the default.



In the Block Editor, you can add parameters and actions to objects in the block to make it dynamic.



## Parameters

Think of parameters as dimensions that control the block geometry. For example, in the Door-Imperial block, a linear parameter was used to define the door size and wall thickness.

Parameters are the first addition you make to dynamic blocks. They define aspects of the geometry that you want to control with actions. There are ten parameters available on the Block Authoring Palette:

### Ten Parameters

	Point	Displays an X,Y coordinate position in the drawing.
	Linear	Displays the distance between two points. Only the distance, not the angle, can be changed.
	Polar	Displays the distance between two points and an angle value. Both the distance and angle can be changed.
	XY	Displays a pair of horizontal and vertical dimensions from a specified base point.
	Rotation	Defines an Angle option.
	Alignment	Forces the entire block to rotate at an angle defined by another object in the drawing. This parameter does not need to have an action specified with it.
	Flip	Describes a line across which the block or selected objects can be mirrored. You need to associate a flip action with it.
	Visibility	Controls the visibility of objects in the block. Automatically creates a list of the visibility states that you define for the block. This parameter does not need to have an action specified with it.
	Lookup	Creates a list of options stored in a table from which you can select. Typically this can hold various sizes related to other parameters and actions.
	Basepoint	Sets the default location of the basepoint for the block definition.

At least one parameter must be specified in a dynamic block. In most cases it has both a parameter and an action associated with the parameter.

Turn on the Block Authoring Palettes on the *Block Editor* tab > Manage panel, click



(Authoring Palettes).

## Actions

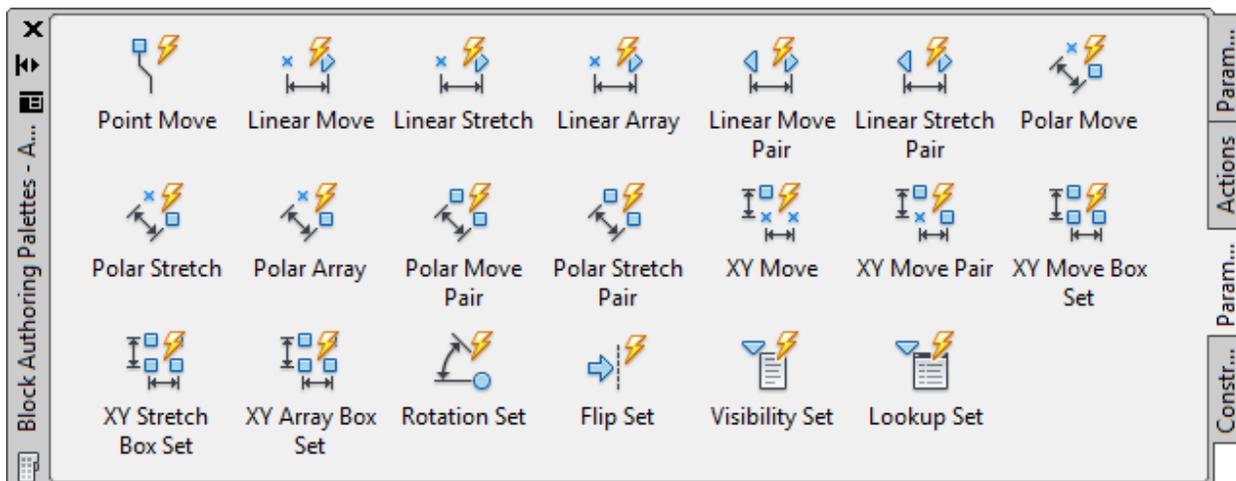
Actions are added to parameters so that you can modify the parameter in the completed block. In the door example, the linear parameter specifies a dimension you want to control. You can add a stretch action to that parameter so that you are able to stretch the door to the required length. To use actions you must associate them with a parameter. Typically you select a key point of the parameter and the geometry you want to include in the action. There are nine actions available on the Block Authoring Palette:

### Nine Actions

	Move	Similar to standard Move command. Works with Point, Linear, Polar, and XY parameters. Action is related to specific grip in dynamic block. Can be linked to entire block contents or to individual objects in block.
	Scale	Similar to standard Scale command. Works with Linear, Polar, and XY parameters and can be linked to entire block or individual objects in block.
	Stretch	Similar to standard Stretch command. Works with Linear, Polar, and XY parameters. Can be linked to specific objects in block. Apply a stretch action to both ends of the parameters if action needs to work both ways. Stretch only works in the direction of the parameter's arrow.
	Polar Stretch	Similar to standard Stretch but includes an Angle option. Only works with Polar parameters.
	Rotation	Similar to standard Rotate command. Works with Rotation parameters and can be linked to entire block or to individual objects in block.
	Flip	Mirrors objects around a reflection line. Works with Flip parameters.
	Array	Similar to standard rectangular Array command. Works with Linear, Polar, and XY parameters.
	Lookup	Works with Lookup parameters. Creates a table in which you can assign data to the block based on the parameter information.
	Block Properties	Defines property sets for the block definition.

### Parameter Sets

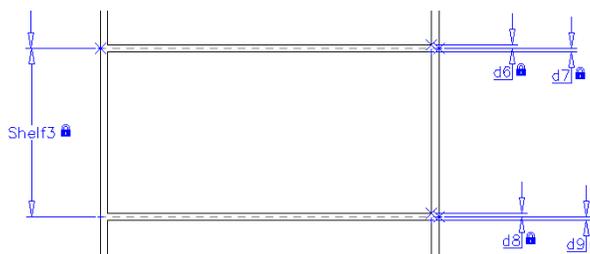
Parameter Sets create both parameters and associated actions at the same time. For example, if you want to flip objects in a block, you can apply a Flip Set and specify the reflection line.



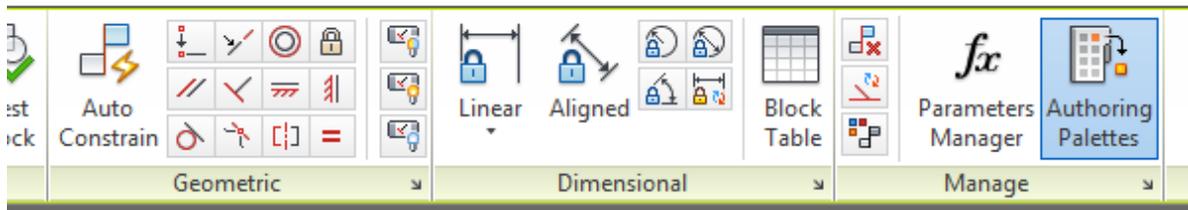
### Constraints

Constraints in a Dynamic Block help to retain the proper shape and geometry of the objects in the block, while the parameters and actions are applied to the objects. Constraints can be geometric or dimensional, and can be found in the Block Editor contextual tab, as well as in the Block Authoring Palettes.

When working with constraints, you might need to dimension an object (such as to the center line of a shelf). However, you might not want the center line to display when the block is in use. The center line can be changed to construction geometry that does not display in the final block.



The methods of applying constraints in dynamic blocks are the same as when you use them in a standard drawing. First, use  (Auto-Constrain) to automatically place as many geometric constraints as possible and then add the dimensional constraints or additional geometric constraints. You can modify the parameters and add user parameters in the Parameters Manager. All of these tools are located in the *Block Editor* contextual tab.



## Block Tables

In many cases, you want users of a dynamic block to select from a list of sizes rather than using grips to adjust the block. To do this, set up a Block Table using specific parameters that were created using constraints.

- A dynamic block can only have one block table.

## Edit and troubleshoot common block creation problems

When you create constraints in a dynamic block, the block must be fully constrained to work properly. Being fully constrained means that all relevant geometric and dimensional constraints have been applied. If you do not do this step, the block might not work correctly.

- The block must have at least one fixed constraint. Click  (Fix) in the Geometric panel and select a location for the constraint. This can be the same location as the base point.
- To see whether or not objects have been constrained, click  (Constraint Display Status) in the Manage panel. When it is toggled on, all objects that have constraints are displayed in blue

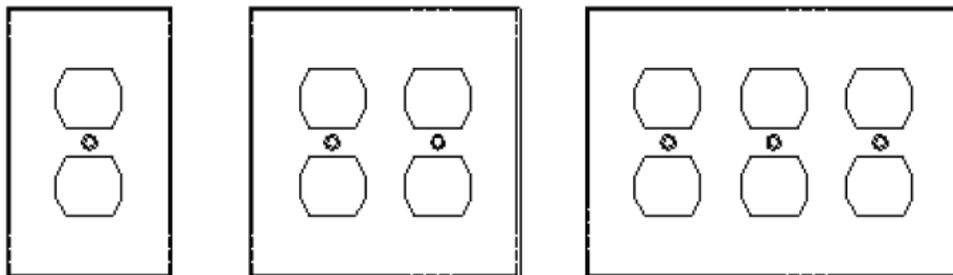
When you are working with a dynamic block that has constraints, testing the block helps to make sure it works correctly. You can now test the block without having to save it and close the Block Editor.

- In the Block Editor contextual tab>Open/Save panel, click  (Test Block).
- When you have finished testing the block, click  (Close Text Block Window) to return to the Block Editor.

When working with block tables, verify that the parameters are working correctly by performing an audit before closing the Block Properties Table dialog box. To perform an audit, click  (Audit) to audit the Block Properties Table. If there are any errors, an alert box opens explaining the problem.

## See it in Action – Exercise 1

In this practice you will create a dynamic block for a receptacle plate that can stretch to display one, two, or three sets of holes. You will apply a **Linear** parameter and Stretch and Array Actions, and set an increment on the parameter.

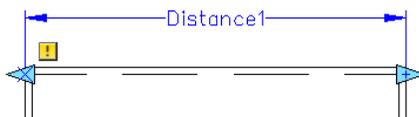


### Start the block.

1. Open **Cover Plate-I.dwg** from your class files folder.
2. Start the **Create Block** command.
3. Name the block **Receptacle Cover**.
4. Select the center of the screw hole as the base point and select all of the objects.
5. Verify that **Open in block editor** is selected and click . The Block Editor authoring area opens and displays the Block Editor contextual tab.

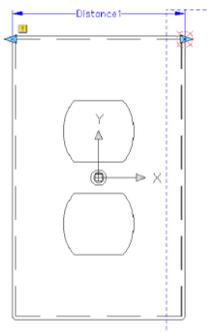
### Add a Linear parameter

1. In the Block Authoring Palettes, in the Parameters tab, click  (Linear).
2. Select the two outer end points to show the full width across the top of the plate and place the dimension. The exclamation point indicates that an action is not yet associated with the parameter.



### Add stretch actions

1. In the Block Authoring Palettes, in the Actions tab, click  (Stretch).
2. Select the **Distance** parameter you just created.
3. Specify the right end point of the parameter to associate with the action.
4. Create a crossing around the right edge of the plate for the stretch frame.



5. Use a similar crossing around the right edge of the plate to select the objects. Do not select the holes, only the edge of the plate. Press <Enter> to complete the command.
6. Repeat the process to add another  (Stretch) action to the other end of the Linear parameter.

### Set up the increment values

1. Select the **Distance** parameter and open the Properties palette.
2. In the Properties palette, set the Value Set.

Value Set	
Dist type	Increment
Dist increment	1.8000
Dist minimum	2.8000
Dist maximum	6.4000

3. Close the Block Editor and save the changes.
4. In the drawing window, test the Stretch Actions. The edge of the plate should stretch to three positions.
5. Right-click on the block **Receptacle Cover** and select **Reset Block** to restore it to its original size.

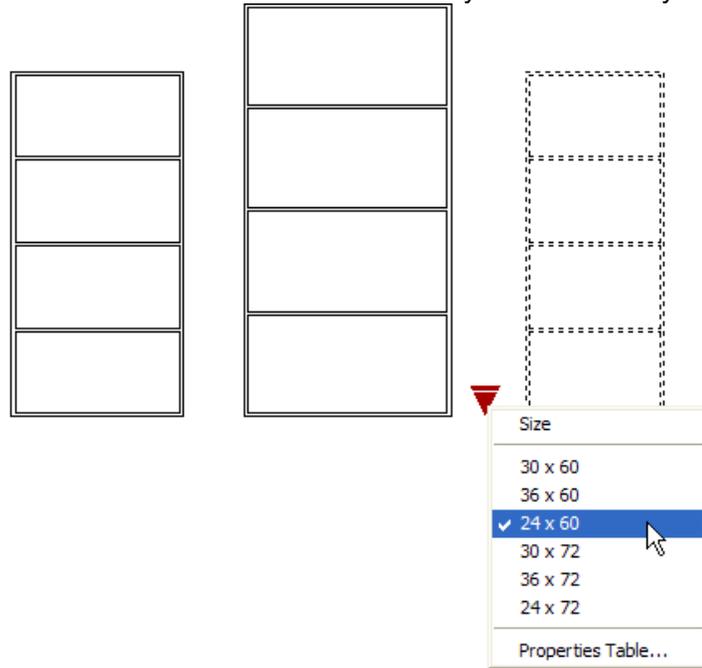
Note: Value Sets work with **Linear**, **Polar**, **XY**, and **Rotation** parameters.

### Create an array action

1. Double-click on the block to open the Edit Block Definition dialog box and click  to edit the block.
2. In the Block Authoring Palettes, in the Actions tab, click  (Array).
3. Select the **Distance** parameter you created earlier.
4. At the Select objects: prompt, select the interior hole objects and press <Enter>.
5. For the distance between the columns, type **1.8** and press <Enter>.
6. Close the Block Editor and save the changes.
7. In the drawing window, test the block again. You should be able to use the stretch grips to display 1, 2, and 3 sets of holes.
8. Save and close the drawing.

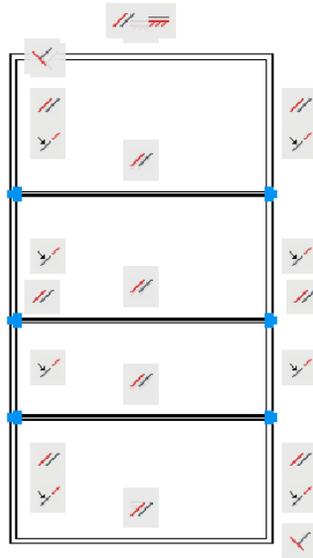
## See it in Action – Exercise 2

In this practice you will add geometric and dimensional constraints to objects in the Block Editor. You will modify dimension parameters and create user parameters, assigning values and formulas. You will test the block and flex the parameters to test how it works. Finally, you will create a Block Table with sizes so that the block can only be modified by size.



### Create geometric constraints

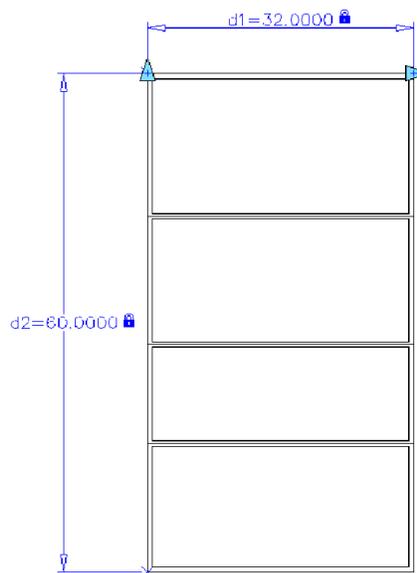
1. Open **Bookcase.dwg** from your class files folder.
2. Double-click on the block **Bookcase-Elevation**.
3. In the Edit Block Definition dialog box, click . The **Bookcase-Elevation** block objects open in the Block Editor authoring area, and the *Block Editor* contextual tab displays.
4. Close the Block Authoring Palettes.
5. Verify that all of the constraint types are set to **Apply** (except for **Equal**) in the AutoConstrain tab of the Constraint Settings dialog box.
6. In the Block Editor contextual tab>Geometric panel, click  (Auto Constrain).
7. Select all of the objects in the drawing and press <Enter>. The parameters display as shown on the next page.



8. Review the parameters that were placed. They include **Horizontal**, **Vertical**, and **Perpendicular**, and many **Parallel**, **Colinear**, and **Coincident** constraints.  
Note: At least one Fix constraint must in the drawing to fully constrain the block.
9. In the Geometric panel, click  (Fix). Place the point in the lower left corner of the bookcase elevation.
10. In the Geometric panel, click  (Hide All) to turn off the geometric constraints.

### Add dimensional constraints

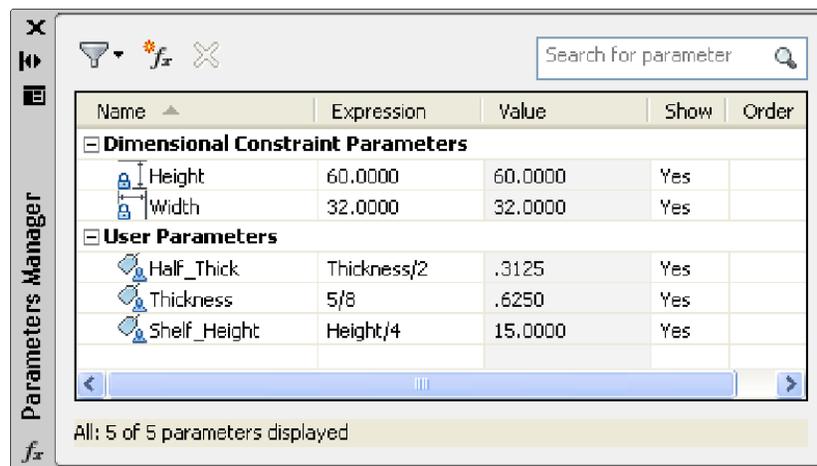
1. Click  (Linear) to add two linear dimensions to the overall top and side. Press <Enter> to accept all defaults.



2. In the Open/Save panel, click  (Test Block).
3. Use grips to resize the block. Only the outside rectangle moves. The inside objects are not yet connected.
4. Undo any changes.
5. Click  (Close Test Block Window).

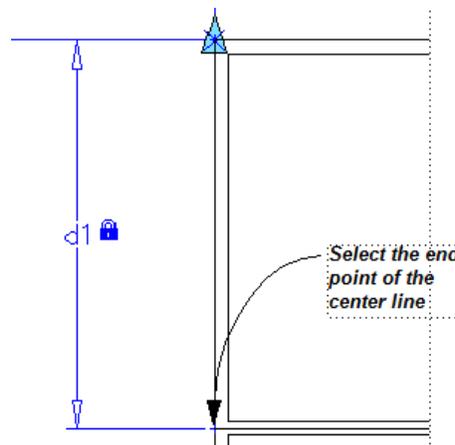
### Create user parameters

1. Open the Parameters Manager.
2. Change the name of the horizontal parameter to **Width** and the vertical parameter to **Height**.
3. In the Parameters Manager, click  (Create user parameter) and add three user parameters with expressions.

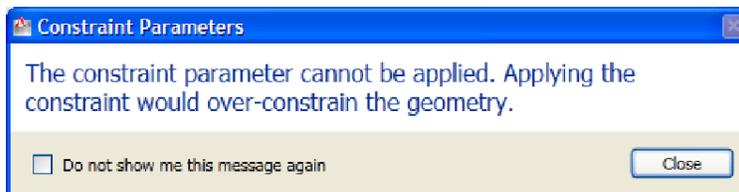


### Continue constraining geometry

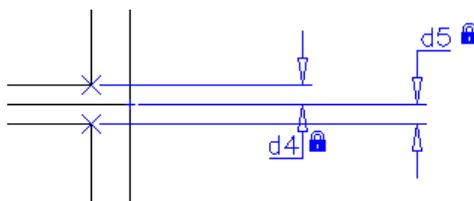
1. In the Block Editor, zoom in to the top of the bookcase and the three shelves.
2. Add a Linear constraint between the top of the bookcase and the centerline of the first shelf. Accept the default name and distance.



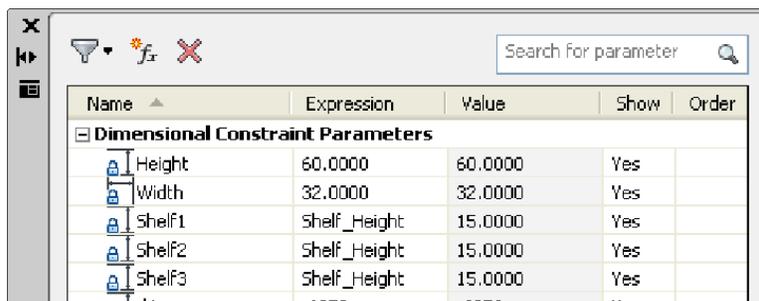
3. Add Linear constraints between the other bookshelves. Accept the default name and distance. Select the end points of the center lines of the shelves rather than the shelf geometry.
4. If you try to add a Linear constraint between the bottom shelf and the bottom of the bookcase, an alert box opens, as shown in Figure 5–46, prompting you that adding this constraint parameter would over constrain the geometry. Click . The constraint is not placed.



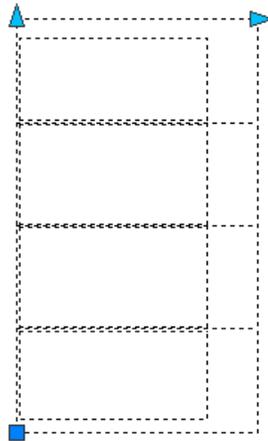
5. Zoom in to a shelf intersection on the opposite side of the bookcase. Add two linear constraints using the default name and distance, as shown in Figure 5–47. This constrains the shelf geometry to the center line of the shelf.



6. Repeat with the other two shelves.
7. In the Parameters Manager, change the name of the three shelf center line location parameters to **Shelf1**, **Shelf2**, and **Shelf3**. For each of them, set the Expression to **Shelf\_Height**.



8. As you do this, the shelves move into place. Because the shelf thicknesses are constrained to the shelf center line, they move as well.
9. Click (Test Block).
10. Use grips to modify the height and width of the bookcase. The shelves move correctly, but some constraints are missing.



11. Undo any changes and click  (Close Test Block Window).
12. Linear constraints are missing for the thickness of the wood around the outer edge of the bookshelf. Add three to the bottom, and one to the top of the bookshelf.



13. Test the block again. This time, everything should correctly.
14. Undo any changes and return to the *Block Editor* contextual tab.

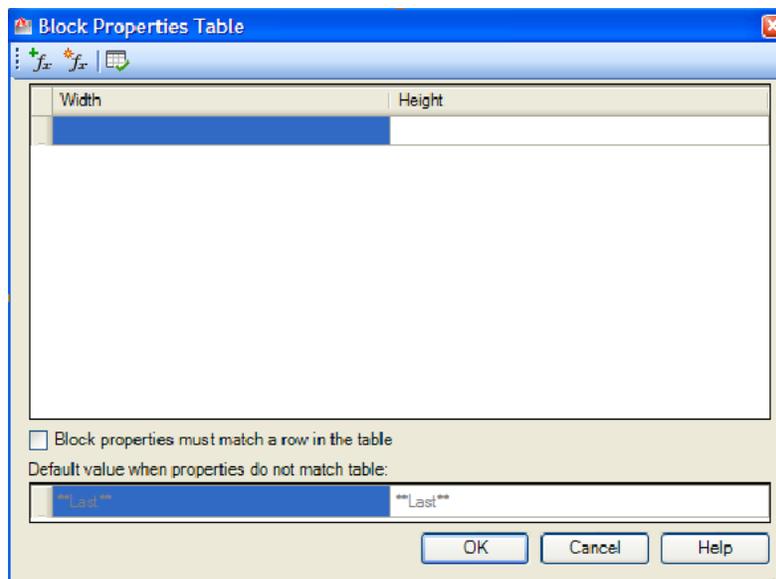
### Clean up parameters

You do not need to change the names of these parameters, as no one outside of the Block Editor needs to see them.

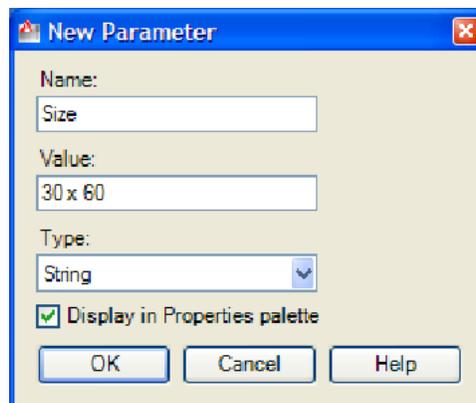
1. In the Parameters Manager, change all of the  $0.625$  expressions to **Thickness** and all of the  $0.312$  expressions to **Half\_Thick**. This enables you to change the thickness of the wood used and have all related items update.
2. Test the parameters by changing the *Expression* of the **Thickness** parameter to **1/2**. Verify that everything moves correctly.
3. Change it back to **5/8** and check again.
4. Test the **Height** and **Width** parameters using several different sizes. End with a *Height* of **60** and a *Width* of **30**.  
Note: Construction geometry does not plot or display outside the Block Editor contextual tab.
5. In the Block Editor contextual tab>Manage panel, click  (Construction Geometry). Select each of the three shelf center lines. Press <Enter> to end the selection set and <Enter> again to convert them to construction geometry.

### Create a block table

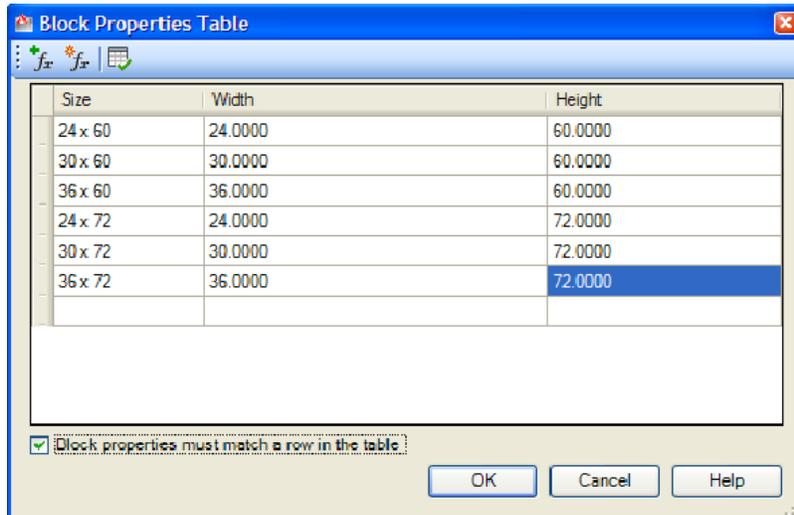
1. In most cases, an object (such as a bookcase) are available in specific sizes. Creating a Block Table sets up a list of sizes that can be used when inserting and manipulating the block.
2. In the Dimensional panel, click  (Block Table).
3. Select a parameter location near the lower left corner of the bookcase and set it to display **1** grip.
4. In the Block Properties Table dialog box, click  (Add properties...) to add an existing parameter to the table. Select both **Width** and **Height**. (Hold down <Ctrl> to select both.) Click . The table is displayed as shown below.



5. Click  (Add parameters...) to add a new parameter named **Size**. Set the Value to **30 x 60** and set the *Type* to **String**. Click .



6. In the Block Properties Table dialog box, drag the Size column to the beginning of the row.
7. Fill out the table as shown below.



Note: Select the **Block properties must match a row in the table** option to restrict the block to only being resized using the sizes available in the table.

8. Click  (Audit) to audit the Block Properties Table.
9. If the table contains any errors, the audit can fix them. If the table does not contain any errors, click  to close it.
10. Save the block and close the Block Editor.
11. Test the block in the drawing.
12. Insert several copies of the block and set them to different sizes.
13. Save the drawing.

## Summary

The goal of all AutoCAD users is to be more efficient. Reusing the same block with slight modifications will help reduce the number of picks and clicks you have to do as well as reduce the number of blocks you have in your block library. If you have further questions regarding dynamic blocks, send them to [mrasnussen@rand.com](mailto:mrasnussen@rand.com).