

Geometric Constraints

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Introduction

The previous two tutorials introduced you to the many facets of one-half of parametrics, dimensional constraints. Recall that the second half consists of geometric constraints. *Geometric constraints* position objects in drawings, as well as attach them to each other. You use the **GeomConstraints** command to make objects to be parallel to each other, or to be centered on one another, and so on.

Geometric constraints are like sticky object snaps. Whereas osnaps last only for the instant during which you apply them, geometric constraints last for as long as you need them to. Geometric constraints can be tricky to figure out; fortunately, AutoCAD provides a command that can figure them out for you: the **AutoConstraint** applies constraints automatically. In this tutorial, you use the following commands:

AutoConstraint – applies constraints to objects, automatically.

GeomConstraint – applies constraints to objects, manually.

Step-by-Step Tutorial: Applying Geometric Constraints

In this tutorial, you learn how to add geometric constraints to drawings, manually and automatically.

1. Start AutoCAD 2010 with the *DimConstraint2.dwg* drawing you saved at the end of the previous tutorial.
2. Try the **AutoConstrain** command on the drawing. Start the command by one of these methods:
 - Enter the **AutoConstrain** command at the keyboard.
 - Or, click the ribbon's Parametric tab, and then choose the **AutoConstrain** button in the Geometric panel.
3. Notice that AutoCAD prompts you:

Select objects or [Settings]: (**Press Ctrl+A.**)

Press **Ctrl+A** to select all objects in the drawing.

AutoCAD constrains the rectangle to force the sides to be parallel and perpendicular, but it ignores the circle, because AutoCAD did not find any geometric relationships involving the circle. (We do that manually later in this tutorial.) Let's look at what AutoCAD did:

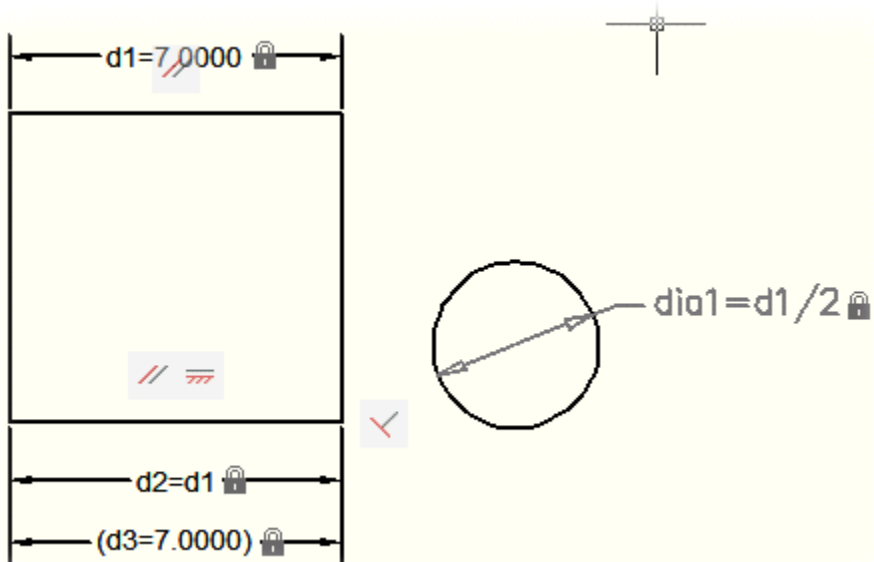


Figure 1: Rectangle is automatically constrained.

4. Notice that the drawing contains four symbols. These are called “constraint bars,” and are tiny toolbars that identify constraints in drawings. (They can be toggled on and off with the **ConstraintBar** command.)
5. Position the cursor over one of the small constraint bars. See figure 2. Several new things appear in the drawing:

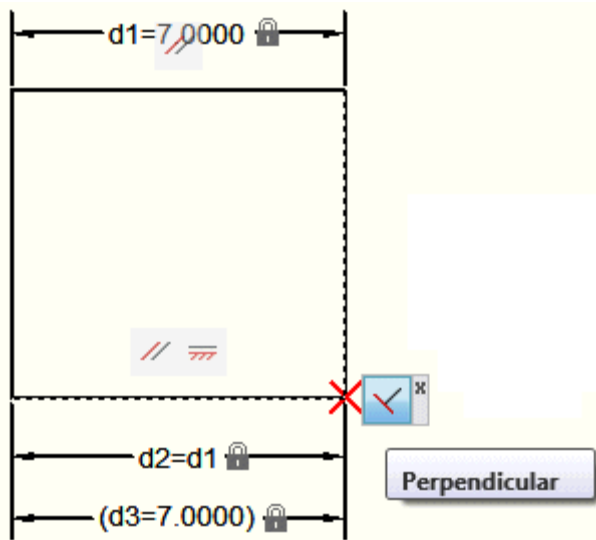


Figure 2: Highlighting a constraint bar.

The constrain bar looks more like a tiny toolbar. Clicking the small x hides the constraint bar. This is useful when drawings contain too many of the little critters. (You bring them back with the **ConstraintBar** command's Show option.) The related objects are highlighted. This lets you know which are affected by the constraint. If you chose the perpendicular constraint, the intersection of perpendicularity is indicated by a red icon.

6. Pass the cursor over all four constraint bars to see the relationships that they define:
Perpendicular constraint bar -- two lines are forced to be perpendicular to each other.
Parallel constraint bar -- the two horizontal lines are forced to be parallel to each other.
Horizontal constraint bar -- the bottom horizontal line is forced to be horizontal.
Because it is constrained in parallel with the top line, the top one is also forced to be horizontal.

TIP The rectangle is fully constrained. This means it has precisely the correct number of constraints to keep it from becoming a parallelogram or trapezoid or other rectilinear shape. If it had too few constraints, then it is known as under constrained. The other possibility is that it could be over constrained (too many constraints), but AutoCAD does not allow that.

7. With the rectangle fully constrained, try to stretch it using grips. You are able to only move the rectangle, not stretch it or resize it. These other editing operations are permitted but with certain limitations:

You can rotate it under the two conditions displayed by this warning dialog box:

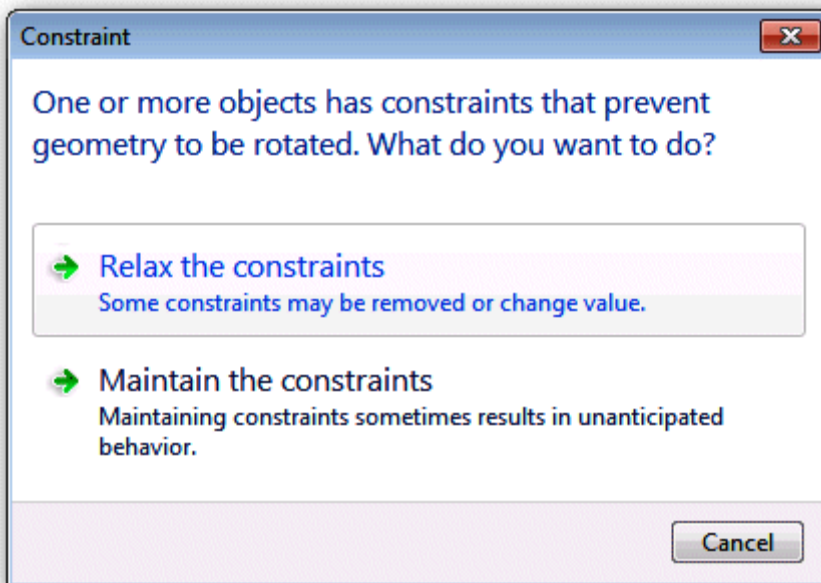


Figure 3: Warning of rotating constrained objects.

Relax -- AutoCAD “relaxes” one or more dimensional and/or geometric constraints so that you can rotate the object. In this tutorial, the horizontal constraint is removed, and the dimension constraints change their values. See figure 4.

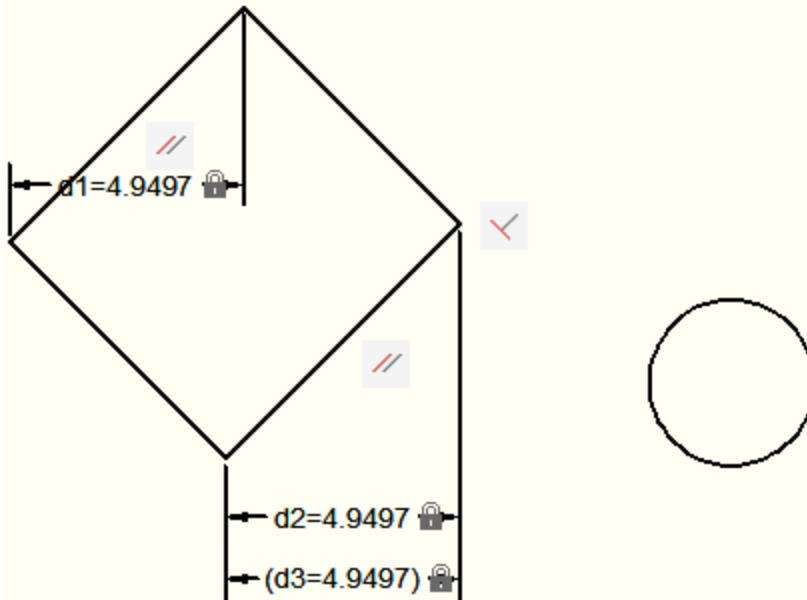


Figure 4: Result of rotating by 45 degrees with relaxed constraints.

Maintain -- AutoCAD warns that unexpected behavior may occur, as illustrated below.

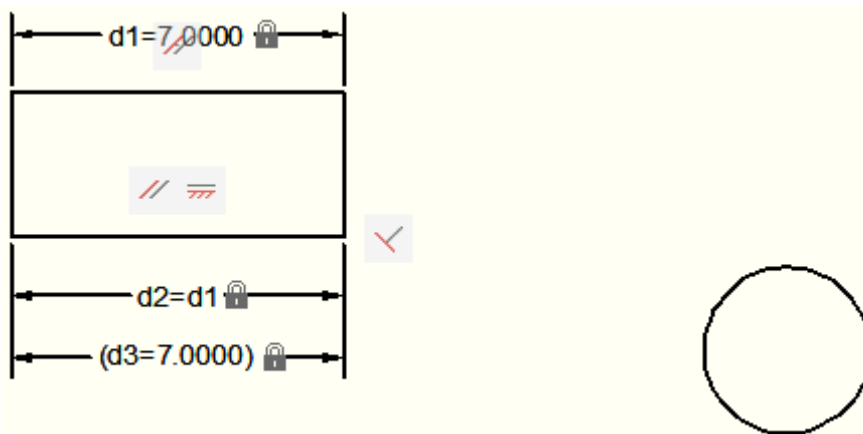


Figure 5: Result of rotating by 45 degrees with maintained constraints.

You can scale the rectangle, but only vertically, because the dimensional constraints keep the rectangle from changing size horizontally.

You can mirror it just as you might expect it to do.

8. Let's now apply geometric constraints manually. The AutoConstrain command had ignored the circle, so let's force it to stick to the side of the rectangle.

In the Geometric panel of the ribbon's Parametric tab, click the **Tangent** button. The prompt asks you to pick an object. In this case, you pick one of the vertical lines, and then the circle:

```
Command: _GeomConstraint
Enter constraint type
[Horizontal/Vertical/Perpendicular/PARallel/Tangent/SMooth/Coinciden
t/CONcentric/COLlinear/Symmetric/Equal/Fix] <Coincident>:_Tangent
Select first object: (Pick one of the rectangle's lines.)
```

Select second object: (*Pick the circle.*)

Notice that the circle jumps to the line.

9. Try moving the circle side to side. Notice that the rectangle sticks to the circle.
10. Move the circle vertically. Notice that it slides along the line. This means that the circle and line are partially constrained.
11. To fix the circle in place takes another geometric constraint. Reapply the **Tangent** constraint, this time between a horizontal line and the circle.
Now when you move the circle, the rectangle always moves with it, no matter the direction.
12. Save the drawing for the next tutorial as *DimConstraint3.dwg*.

Related System Variables

ConstraintBarMode determines which geometrical constraint icons are displayed on constraint bars.

ConstraintBarDisplay toggles the display of constraint bars, after constraints are applied.

ConstraintNameFormat switches the format of text in dimensional constraints: name, value, or expression.

ConstraintRelax toggles between enforced and relaxed constraints when objects are edited.

ConstraintSolveMode toggles the behavior of constrained objects when constraints are applied and edited.

Test Yourself

1. How does the `GeomConstraint` command differ from the `DimConstraint` command?
 - a. `GeomConstraint` attaches geometric constraints; `DimConstraint` attaches dimensional constraints.
 - b. `DimConstraint` attaches geometric constraints; `GomConstraint` attaches dimensional constraints.
 - c. `GeomConstraint` attaches geometric constraints; `DimConstraint` removes them.
 - d. `DimConstraint` changes the visibility of geometric constraints; `GeomConstraint` changes the style of dimensional constraints.
2. When would you use the `AutoConstraint` command?
 - a. As the final step in attaching dimensional constraints.
 - b. To automatically adjust the spacing between dimensional constraints.
 - c. You wouldn't; there is no such command in AutoCAD.
 - d. As a first step in attaching geometric constraints automatically.
3. Objects can be controlled by more than one geometric constraint.
True / false.
4. Constraint bars display icons of geometric constraints attached to one or more objects.
True / false.
5. When should you relax constraints?
 - a. Never.
 - b. When objects need to be edited independently of constraints.

- c. When the drawing is ready for printing.
- d. When you switch from model space to paper space.

[Answers]

1. a. *GeomConstraint attaches geometric constraints; DimConstraint attached dimensional constraints.*
2. d. *As a first step in attaching geometric constraints automatically.*
3. *True.*
4. *True.*
5. a. *When objects need to be edited independently of constraints.*

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