Program for Modeling – Adding details to your layout

Working with a 3D Modeling Program, 3D Builder

In this article, the goal is to introduce you to a program which you already have access to through Microsoft applications. The application that we are going to work with is named 3D Builder. This is a free program that can be downloaded if not in your initial Microsoft library. It is a program that does not require an engineering background nor a detailed understanding of Computer Aided Design (CAD). Besides this program, there are many programs available on the web for developing 3D models, some free and some that you must purchase. If you are new to creating 3D models, I strongly urge you to consider the 3D Builder as your first program. **Figure 1** is a screen shot of the program when first launched. I would suggest that before going on with this tutorial that you either download and launch the program or if it is already on your computer,

Figure 1
Title page of 3D Builder

launch the program and that way you can see the various commands full scale rather than the small print found in this document.

Before delving into the program, we must first visualize the space that we are going to be working in. A 3D model is one that is drawn using X, Y, Z reference frame. X being the position to the left or right of a center point defined as 0, 0, 0 by the program. Y is the position to the front or back of the center reference point (picture a pencil being pushed into the screen or being pulled out of the screen), and Z is the location up or down from the center reference point. Please note that further on, the reference point may change from the 0, 0, 0 center of the initial screen presentation. A minus in front of X position moves the object to the left of the 0. A negative in front of the Y position moves the object "out" the page while a negative in the Z axis moves the object down.

As we go through the program, when manipulating an object, you must first move the cursor over the object and click on it.

The menu items shown on the left of the screen in **Figure 2** come up when you select a new scene and are used to manipulate all objects. The topmost command is Group. If two or more objects have been inserted and manipulated to a desire position to create a model or a portion of a model that you want to duplicate, highlighting the Group command will make join these two or more objects as a single object for moving, copying, and pasting. The second command is an Ungroup command.   This is useful if you want to make multiple copies of an object but need to modify one of the

Figure 2
Screen Shot of Opened Program

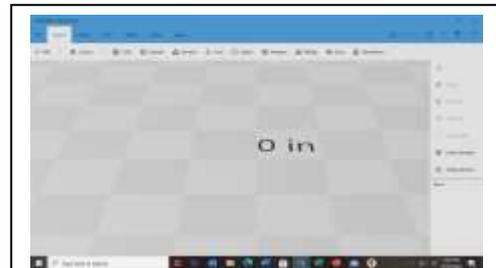shapes making duplicates of the object. Selecting the Ungroup command highlights each individual shape in the object.

The next command is Select All. This is useful if you have multiple objects in the print envelope and want to make them one object. You select all and then group and all objects have been combined into one model.

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This is followed by the Deselect function. I have found this to be one of the more useful commands. If more than one item is highlighted, and you chose to move one of them, they all will move. You must use the Deselect command in order to only select one object for manipulation.

The last two commands are Invert and Sticky. When an object is highlighted and the Invert command is selected, the object is no longer highlighted. I have never used the Sticky or Invert command in any of the model work I have done.

The premise of this application is that most 3D models consist of several basic geometric shapes. Figure 2 is a screen shot of a new file before anything has been added. There are two tool bars at the top. The uppermost one selects a specific function and the one under it is the actual activity to be implemented. You move the cursor over the top bar and click once. In this screen shot, we have selected the action to insert a shape.

The shapes available in this program are shown below the Insert command shown in **Figure 3**. Across the screen, the first standard shape is a cube. It is followed by a Cylinder, a Pyramid, a Cone, a Sphere, a Hexagon, a Wedge, a Torus and finally a Tetrahedron. On the far left there is the ability to add a shape you have created and use frequently on many models. The second one across the tab is a custom shape. Using this tab, you can modify the number of triangles that make up a shape.
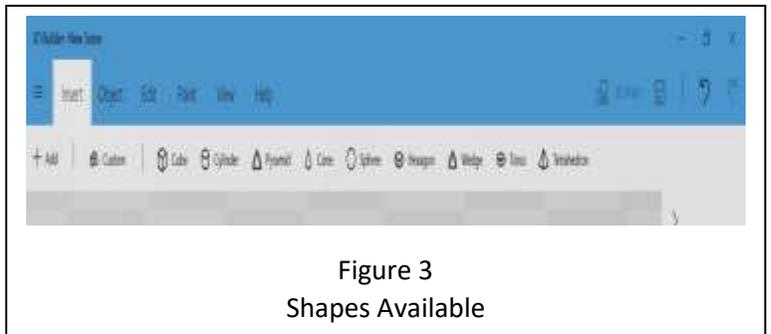
Figure 3
Shapes Available

Selecting cube form, **Figure 4**, I have inserted a cube into the design area. When the cursor is placed over the cube and clicked, a dialog box will appear at the bottom of the screen. Data inputted in this dialog box is used to manipulate the location of and the dimensions of the cube. The three icons on the left when selected allow you to move the cube to specific locations in the X, Y and Z frame. On the far right is the coordinate system being used, either Metric or Imperial. For the examples in this tutorial, all dimensions are in English. The default mode when the model is selected is the icon on the far left that allows you to enter a new position for the cube within the print envelope. Note that once you have move an object to a
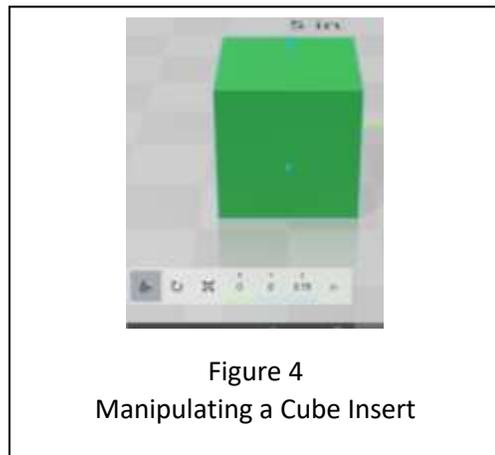
Figure 4
Manipulating a Cube Insert

specific position within the print envelope, any manipulation of the object dimensions will be around these new coordinates, not the initial 0, 0, 0 location that is the default location when inserting a new object. Back on the left side of the bar is an arc and a rectangle with arrow pointing out from each corner. When the arc is selected, you may rotate the object in three dimensions, roll, pitch, and/or yaw. Roll is taking the object and rolling it around the X plane. Again, you will use either a + or – sign in front of the angle you want. All data is inputted in degrees with an X.XXX format. The Angle that appears below the pitch, roll, or yaw will only show to the second decimal point, but it will position the object to the third

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decimal point as shown in a second dialog box that opens when you click on X, Y, or Z. Note that these degrees are always relative to the initial plane of insertion.   Pitch is rotating the object in Y plane.   And yaw rotates the object in the Z axis. When you combine the three linear motion with the three angle motions you are capable of moving the object in a total of 6 degrees. Note that when entering new data in the secondary dialog box, you must click accept or the new data will not be accepted. Besides entring a specific angle to move the object, you may also grab one of the arrows around the object in the three dimensions and manually move the object. As you move it, you will see the angle being created in the dialog box.

The box with the corner arrows is used to change the dimension of the object. Again, when selected, you have two options to change the dimension of the object. The first is to enter data for Z, Y and or Z. The object will appear on the screen with arrows pointed in each direction. As in the rotary motion, you select one of the arrows, you move in the direction you desire and see the new dimension in the number below the dialog box. **Figure 5** shows several cubes of the same size but in different pitch, roll and yaw orientations.
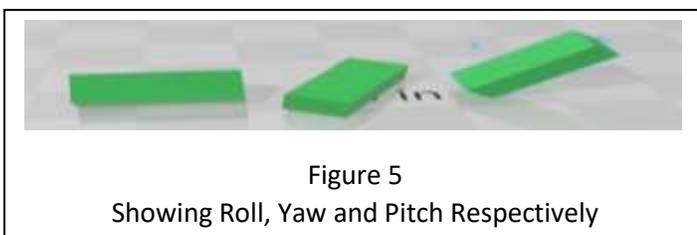

Figure 5
Showing Roll, Yaw and Pitch Respectively

The above discussion is applicable to each of the objects that you can insert. Please note that when inserting a cylinder, if you change dimensions but want to keep it a cylinder, you must make X and Y the same dimension. For a sphere, you must make X, Y, and Z the same dimension.

Moving over one tab in the top bar is the Object options. **Figure 6** shows this selection and the options that are available. Starting from the left side, the first option is the duplicate function. When an object is selected (put the cursor over the object and click, it will show the measurement status window) and the duplicate

Figure 6
Option Tab

option had been selected, it will be copied and show next to the original item. If an item is selected and the copy option is selected, the object will be saved to memory and can be exported to other files. This is useful if you are making parts that must interface with each other, copying from one file to a second file allows you to verify that they will properly interface. The cut option will delete the object, doing the same as the delete icon. (Note: I do not know why they have two ways to delete.) The other way to delete an object is to use the delete key on your keyboard.
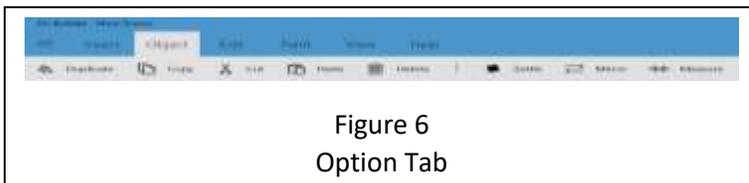
The Paste function is used when the copy function has placed an object in memory. When you paste an object, you can then move it around using the position functions describe at the beginning.

One of the most useful and critical icons in the object folder is the Settle function. If you have move dimensions around and need to get back to a fixed reference point, the Settle function will put the object flat to the printing plane. **Figure 7** shows on the left a rectangle that is flat against the drawing plane while the rectangle on the right is the same item but at an angle. The other use of this function is to settle the final model against the drawing plane. This is the last command selected before going to a slicer program.

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If the model is not flush with the drawing plane it will not be flush against the print table and that will create either a model that cannot be printed or a corrupted model.

The Mirror function rotates the object around its center point. You can see the change in the linear information window as you select mirror icon. Finally, the Measurement icon allows you to take a measurement between two points. Use caution when selecting this icon and monitor carefully where the two arrows are. A line will be drawn between the two arrows. You need to rotate the item to make sure the arrows are attached at the points that you are measuring.

If you use any of these functions and discover you made a mistake, using the two curved arrows on the upper tool bar will undo what ever change you just made. The one on the left undoes the change, while the one on the right redoes the change. And these arrows will go back or forward more than just the last move. So, if you made a mistake four moves back, you could undo the last 4 changes and correct your mistake. However, any changes you made to the object after the correction point will have to be redone. If you move forward, it will undo your correction(s).

The next tab on the top tool bar is the Edit tab. When selected, **Figure 7** shows the options available in Edit mode. This first option simplifies the models surfaces. A 3D model is made up of many small triangles. The more

Figure 7
Edit Option Tab

triangles the better the detail of the printed model, but it also increases the amount of material used. Also, the more detail you have, the longer the print time. Select the model and select simplify. There is a draw bar that allows you to select the percent of simplification. You will have to play with this feature with your specific model to determine the best setting.
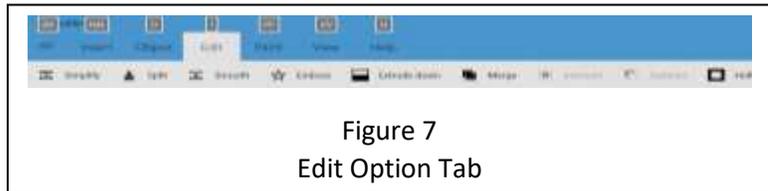
The next tab is the Split tab. You select an object such as the rectangle and using the split feature, cut it in half. In **Figure 8**, you will see three items on the left that were selected to be split with only the top being saved as shown on the right-hand side. **Figure 9** takes the middle object, the
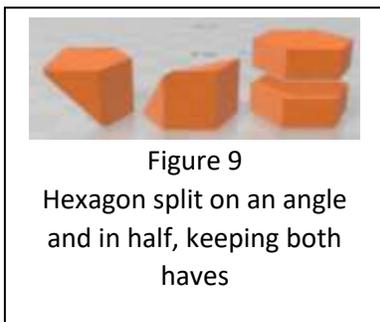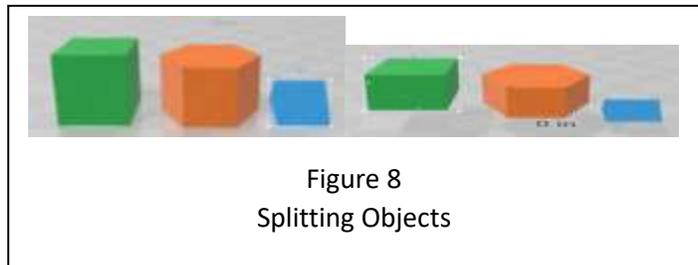
Figure 8
Splitting Objects

Hexagon to demonstrate the split function. The two figures on the left side have been split it on two different angles, only keeping ½ of the split. The figure at the far right is the Hexagon that was split in the idle and both pieces kept. This is a useful feature when generating some models. For instance, if you needed a funnel, you would start with a cone and split it. Keep the half that does not come to a point and you have a funnel.

Figure 9
Hexagon split on an angle and in half, keeping both haves

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Since I like piping around industrial buildings **Figure 10** is an example of a custom pipe using the following shapes (2) and operations (3):

1) Objects:
   a. Cylinder (2)
   b. Cone
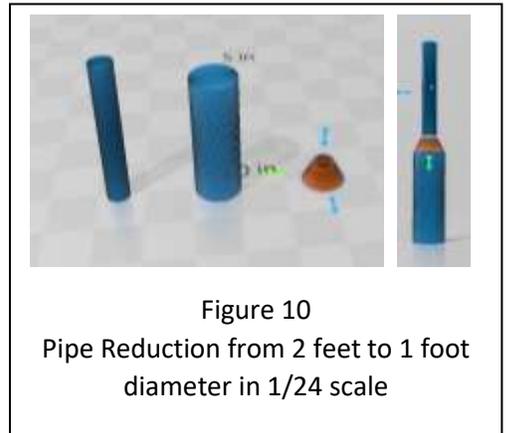2) Functions
   a. Insert
   b. Split
   c. Merge

Figure 10
Pipe Reduction from 2 feet to 1 foot diameter in 1/24 scale

I have drawn a cylinder representing a 1 foot pipe in 1/24 scale, a 2 foot pipe and a cone that has been split to mate the two together as shown in **Figure 13**. In an industrial model the would be used to indicated the potential to increase the pressure (with constant flow from a pump, restricting the flow diameter will increase the pressure). Likewise, for high pressure in the small pipe, the larger pipe will reduce the pressure.
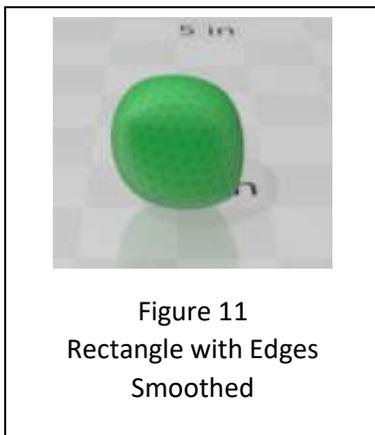

Figure 11
Rectangle with Edges Smoothed

The next tab is the Smooth tab. When an object has been highlighted and then the smooth option is selected, the sharp edges are smoothed. This is shown in **Figure 11** for a standard rectangle that was highlighted.

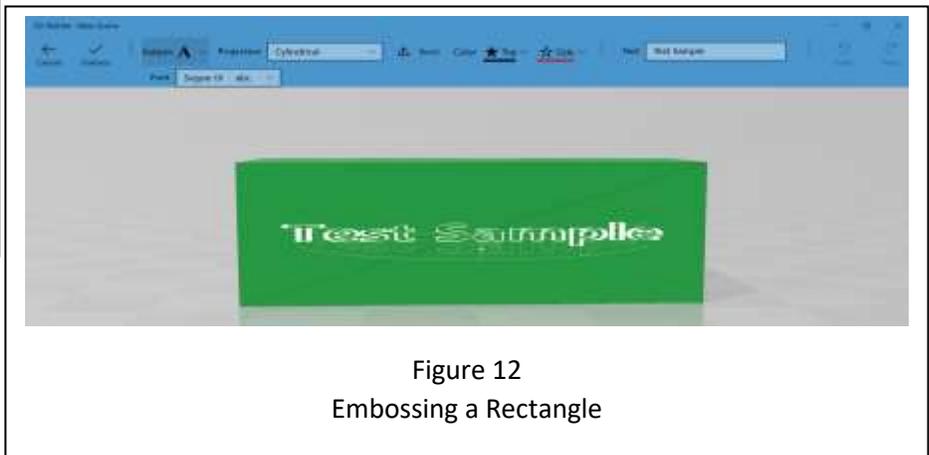The next tab is the Emboss tab. Using this tab, you can add legends to an object. **Figure 12** shows a rectangle with words Text Sample embossed on it. Looking at the blanks across the top, you can select the

Figure 12
Embossing a Rectangle

color of the sides and top of the letter to make it easier to see the effect. You can have the words embossed in plane form, cylindrical, or spherical. Once you have entered your text you must select the emboss on the left side or the cancel tab if you decide not to emboss. Move the cursor over one of these and click.

The next tab is the Extrude down. If we raise up the 2 foot pipe and use the extrude menu, it will double the length of the 2 foot pipe.

The next tab is the Merge tab. I lined up the components to recreate the shape in **Figure 10**. Once lined up, you can use the list of commands to the right side and click on select all. Once all are selected, highlight Merge command. You now have one object which can now be repositioned and/or resized. There is

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another way to select all. Holding the shift key down, click on each item to be merged and then hit the Merge command.

Going back to the action bar, the next action is Intersection. If you position two or more items in such a manner as they intersect, you can select all items and active the Intersection icon. The result is only the object created where the object intersects as shown in **Figure 13.**
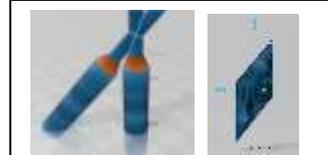

Figure 13
Result of two objects intersecting

The next command is Subtract. In **Figure 14**, we have inserted a Hexagon smaller than the diameter of the larger pipe. It was than manipulated so that it went through the larger pipe. With the Hexagon selected, the Subtract icon was highlighted with the resulting hole through the larger pipe.

The last command is the Hallow command. When an object is selected, the hollow command will remove interior material leaving a wall thickness as set by the slider in the dialog box that opens when Hallow is selected. This can reduce the amount of material used in the final print. It may also weaken the final model.

Figure 14
Subtracting a Hexagon rod from the larger pipe in the earlier merge example

If you are making something that needs a hollow aspect, I would suggest that you use a shape representing the hollow portion of your model and subtract it. I have done this for wastebaskets for office furniture, for garbage cans for trash scene and for pipes which I will discuss in a future article.

We will cover the rest of the commands in this program in the next addition of this series.

Note: If you have questions or comments about this article, please email me direct at cbartel@roadrunner.com. Hopefully this will shorten the total time needed to get an answer to your question(s) and incorporate any comments in future document regarding 3D printing. Questions that have universal appeal to 3D printing will be posted along with the answer, but the person submitting the question will not be listed.