

# Program for Modeling – Adding details to your layout

## Working with a 3D Modeling Program, 3D Builder

Welcome to the sixth article in this series of 3D modeling. In this article, we will review quickly the trackside building, moving on to a gas distribution house using the track side as a base. In article 7 we will move on to how to design larger buildings that cannot be printed whole.

As a reminder, these articles are based on the use of a Prusa printer, either the MINI or the Original, and the 3D Builder program from Microsoft. As a service to the readers and hopefully a quick start to your printing adventures, we are including both 3MF and STL files for the model presented in this article. These can be used by any printer when converted to G Code files or other sliced files as appropriate to the printer you are using. If you want to open an STL file and modify it, it will open with the right dimensions if you choose the mm as the file's units. Then check the import model and it will open in 3D Builder.

The STL files provided in the last article when converted to G Code and printed and assembled should look like Figure 1. If you are using a gray PLA filament, or one with silver specs in it, you may want to use it as printed, with the material color representing aluminum.

For my first major project, BLB Solutions, I envisioned a small manufacturing plant of chemicals that would have a three story office building, a one and 1/2 story pump/mix house, a two story distribution pump house, retorts for processing, and a set of storage tanks. There would be a railroad siding to serve it, large enough for one tank car. For reference, Figure 2 is a table showing the relationship between scale inches and actual inches.

In any plant, gas is needed for heating and possibly processing. I added a gas building with a large 12-inch main coming in and two small 6 inch lines for distribution to the facility. The assumption is that this building has manifolds and pressure reducing mechanisms as well as gas metering with reporting to the utility via radio that need to be protected from the weather. All three pipes would come out of the ground and into the gas house to reduce the number of above ground pipes needed in the model.

I took the 3D builder file for the relay shed and put three holes in the sides. One hole, 0.505 -inch diameter was for the incoming 12-inch gas main located on one side and two holes, 0.255-inch diameter, for the 6-inch facility lines on the opposite side. I modified the roof to have a couple of relief vents, located over the supposed gas manifold for the facility lines. I also added the initials NYG&EC for my local utility company. A note was embossed on the door indicating authorized personnel only. After all, we don't want an explosion from an unauthorized person doing the wrong thing! See figures 3 and 4 for the modifications.

This plant has a large number of pipes going between buildings, retorts, and storage tanks. I needed a way to align and assemble these pipes in an efficient manner. After printing a couple of pipes out and trying to glue them together, I found a spent

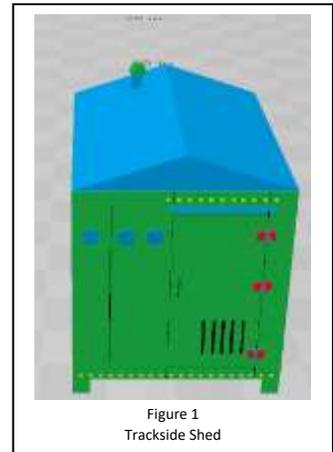


Figure 1  
Trackside Shed

Scale	Actual
1" = 0.042 ft	
2" = 0.083 ft	
2" = 0.125 ft	
3" = 0.125 ft	
5" = 0.417 ft	
6" = 0.500 ft	
7" = 0.583 ft	
8" = 0.667 ft	
9" = 0.750 ft	
10" = 0.833 ft	
12" = 1.000 ft	

Figure 2  
Dimension  
Conversion Chart  
1:24 Scale

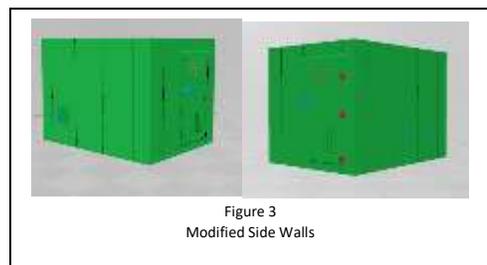


Figure 3  
Modified Side Walls

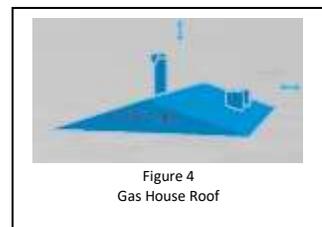


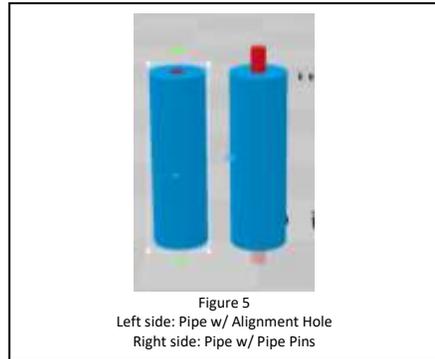
Figure 4  
Gas House Roof

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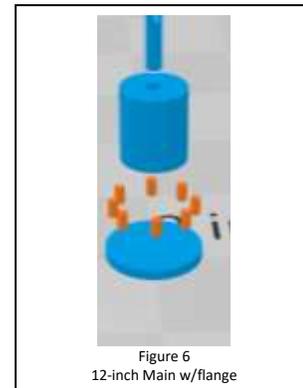
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more time ungluing them from my fingers as I tried to align them. Going back to the drawing board, I have defined as a standard, any pipe design will have a centering hole to which I will insert a pipe pin to assist in aligning the joining of two pipes. I selected 0.12-inch diameter pipe pins of  $\frac{1}{4}$  inch length as my standard for alignment. I created a new view and inserted a cylinder, setting the X, Y, Z parameters at 0.12, 0.12 and 0.25. I print multiple pins at a time, with the pins vertical and with brim. I also print these with 60 to 80 % fill. When I used fill less than this, I broke pins off inserting them into the pipes.

Starting with a second new view, I inserted a cylinder and set the dimension for the pipe size desired. For my project I am using 6 inch and 12 inch diameter pipes, which in 1:24 scale is .25 inch diameter and .5 inch diameter respectively. Note that once the first pipe was designed, additional pipes were printed by simply changing the length (Z parameter). Given the standard alignment pin, I inserted a second cylinder with a diameter of 0.13 inches. I made its length longer than the 0.25 or 0.5 inch diameter pipes. With both cylinders having coordinates X and Y of 0,0, the smaller cylinder is centered in the larger cylinder. Making sure that the smaller diameter pipe is sticking out both ends of the larger pipe and selected, I subtracted it to create a pipe with a centering hole to insert the pipe pins used to align the two pipes. See Figure 5 for a graphic of this activity.



Thinking about how the gas company and the local plant would maintain the incoming gas lines and distribution to the plant, a valve on the 12 inch main to shut off gas to the distribution manifold (not visible, located within the gas house) and valves on the two gas lines going out to the facility were added. I wanted to add some detail to the gas mains based on how I supposed the gas company would install such valves so that they could be replaced in the future. With the main shut off valve connected to the supply line coming in, I put a flange connection between the supply line in and the pipe section with the valve. Figure 5 shows the details of this component. Starting with a cylinder of 0.50 inch diameter and any length you want, I inserted a second cylinder of 0.130 for the centering pin to be inserted into. I inserted a third cylinder with a diameter of 0.75 inches and a height of 0.05-inch providing a flange of a little over an inch thick. Making sure that all cylinders had an X, Y parameter of 0, 0, I settled these to the base. I then lowered the 0.13 inch cylinder so that it extended below and above the 0.5 inch cylinder and subtracted. I now have the core pipe and flange. I then inserted a hexagon with parameters of 0.08, 0.08, and 0.14. This height gave me a bolt head of about 2 scale inches. I placed these around the flange to represent bolt and nut arrangement holding the flange together. See Figure 6.



I suggest that you follow the above process and create your own 12 inch main with flange. Remember to make sure the final design is settled before trying to slice and print. However, the files for this pipe with flange and bolts is included in the STL files being provided with this article.

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Taking the above flange design, I added a valve body by inserting a sphere of 0.7, 0.7, 0.7. With the flange pipe still located at the 0 coordinates, I slide the sphere over the 0.5-inch cylinder, positioning it away from the flange to accommodate the valve handle. A second cylinder of 0.05 diameter and .5 long was inserted and rotated in yaw 90 degrees. This was centered in the middle of the sphere to provide a mounting point for the control handle. Make sure it does not come out both sides and then subtract it. At this point select all and group the individual components to have one file. Again, make sure it is settled before slicing and printing.

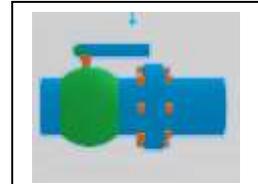


Figure 7  
Pipe Valve and Flange Assembly

You can design any type of operating handle appropriate to your design concepts. I will leave this handle design for you to design and print. Just make sure that the rod connecting the handle to the valve has a diameter of 0.045-inches.

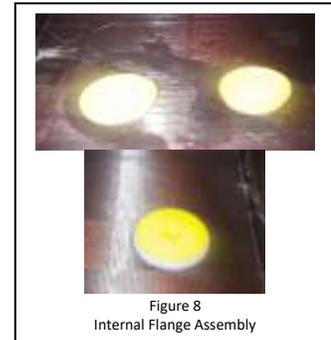


Figure 8  
Internal Flange Assembly

I assembled on gas house using the pipe with pipe flange as described. When done, I realized it is unlikely that there would be a pipe flange in the wall of the building, but rather simply a hole with the pipe passing through. Going back to the pipe with flange and bolts, I removed the bolts and created a new file. Once printed, this item can be inserted into the gas house, with the flange on the inside. See Figure 8 for this assembly approach.

At this point you have a design decision to make. The pipe could come directly out of the gas house if the pipe and hole are a tight fit so that you cannot see the internal flange. The other option is to design a building flange cover and insert it over the pipe and against the building wall. To do this, in a new drawing insert a sphere with a dimension larger than the diameter of the pipe. For the 6-inch pipe, use a sphere with a diameter of 0.35-inch and for the 12-inch pipe, use a sphere with a diameter of 0.8-inch. With the sphere located at X, Y coordinates of 0, 0, insert a cylinder with a diameter of 0.254-inch for the 6-inch pipe and 0.527-inch for the 12-inch pipe. Making sure the cylinder extends through the sphere, subtract it using the edit command. Using the split command, split the sphere keeping the top. I settled the top and lowered the Z axis to 0.1-inch. Save the file, slice and print. Once printed, slide this flange over the pipe to cover the hole in the wall. Figure 9 shows building flanges installed on the 6-inch pipe.

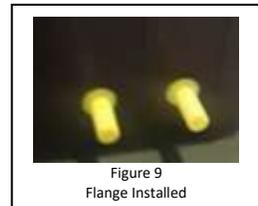


Figure 9  
Flange Installed

Slip a pipe flange over the pipe coming out of the gas house and then mate it with a valve assembly. Make sure the bolt heads line up on either side of the flange indicating through bolts and nuts.

The assembly of the pipe and valve are shown in Figure 10.

Repeat the design process for the 6 inch pipes. Note that you could use any size pipe for your specific design. Just scale the valve and flange components accordingly. You will need to resize the flange and bolt heads for the smaller pipe as well as the valve assembly. Also note that smaller pipes may require smaller pipe pins.

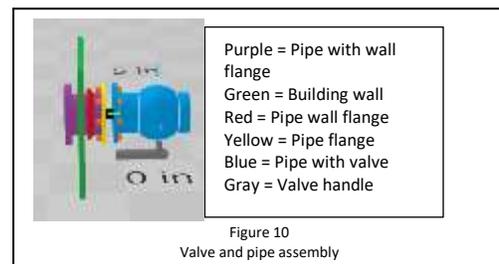
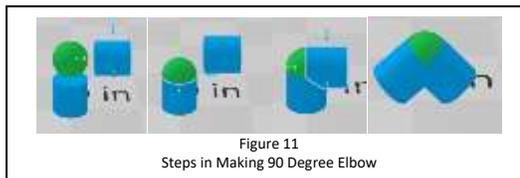


Figure 10  
Valve and pipe assembly

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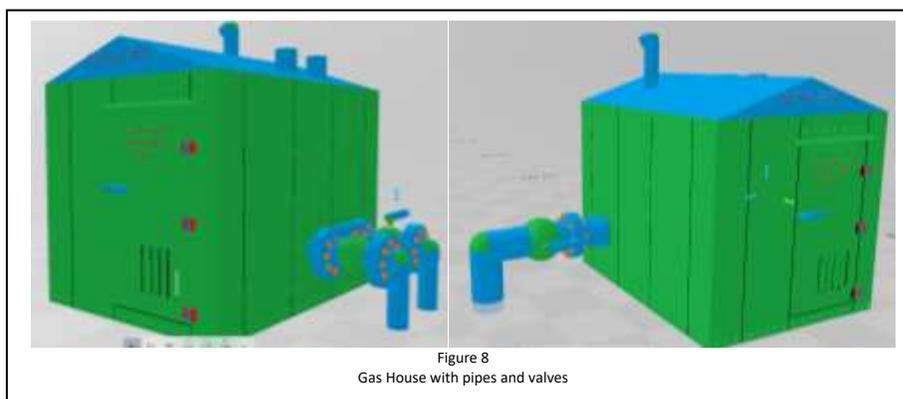
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Since we are designing the gas distribution to be underground, we will need a 90 degree elbow in both pipe sizes. Start with two of the pipe designs with centering hole and place them at 90 degrees to each other. The vertical cylinder needs to be at the X and Y coordinates of 0,0. Both pipes should be of the same length. Insert a sphere with the diameter of the pipe. Move it so that one half of the sphere is inside the vertical pipe. Now move the horizontal pipe so that one half of the sphere is inside that pipe. This should leave only one quarter of the sphere showing. Select all and group. Yaw the assembly 45 degrees and settle. When you slice it and go to print, you will need supports from the build plate depending on your printer. This process is shown in Figure 11. Note that you do not see the pipe pin holes in the two pipes. Just make sure they are there so you have something to align the pipes with.



When you install the valve handles, make sure they are appropriately aligned, either to the top of the side. I have not seen valves with handles at an angle, but if it works for you and looks good, place the handle in any position other than the bottom and lower sides. Bottom and lower sides would only work if the pipes are overhead.

When you are finished, you should have a building that looks like Figure 12.



Depending on the color of the filament you are using you may need to prime and the paint an appropriate color.

Without the roof vents and holes for the gas lines this model could be used for multitude of buildings found around an industrial site, farm or even garden sheds in the backyard. You could modify the finish to represent boards, shingles, concrete, etc.

In Article 7, we will address brick buildings and the issues with matching of bricks at the corner. We will also review window and door components that can be used in any building with a required thickness. In Article 8, we will address building with second and third stories (or more) and some interior details to flesh out a prize-winning building.

Available on the web site are the STL files for the gas house, and in a couple of cases, both the STL and the 3MF files. All designs are done in 1:24 scale. The 3MF files are provided so that you can change a dimension to make longer pipes or other modifications. Also, please note that if you open and STL file, it should open a screen asking about the dimensions of the file. The files, though I have done all design in

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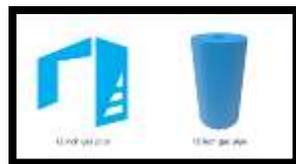
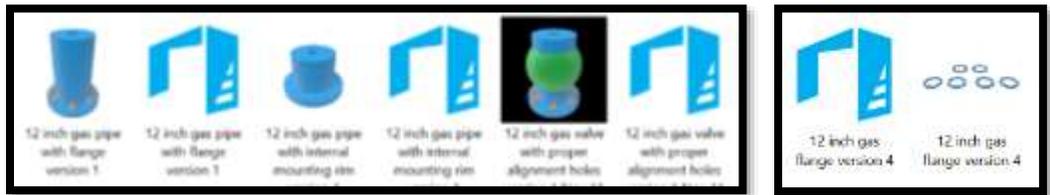
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inches, are saved in mm. Once this is selected the file will open in 3D Builder. Again, these files are offered to all BTOC members for unlimited use for your own layout, a club layout, or as a gift to a friend for their layout. If used commercially, please contact the club to discuss.



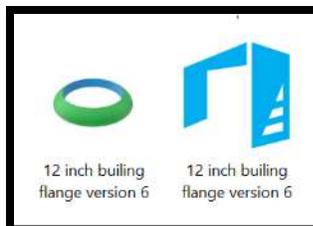
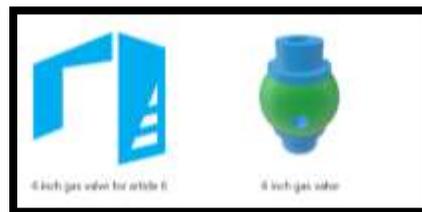
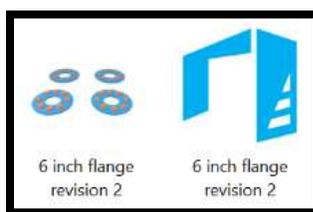
or

Gas House version 5 has no embossing lettering on the door as has the new shell version 1f. You can elect either one for your display. Also note that the one for the new shell version is a 3mf version. The STL version was too large for the server. You must open it in 3D Builder and then save as an STL file.



Please note that we have supplied both 3MF files and an STL files for the pipes. The 3mf file needs to be opened and modified if you want to make difference lengths of pipe. During various assemblies, it has been efficient to assemble the

model and place it in position and then measure the length of pipe needed to the ground. I then print out a specific length of pipe and have a nice model.



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If you try printing out one of these files, and it turns into a ball of twisted plastic, remove the print plate and clean it. On one of the user forms for the Prusa printers, a lady wrote about this problem when others were unable to clean the plate sufficiently that Dawn dishwasher soap is best for this job. It is suggested that you use latex gloves or paper towels to keep any finger grease off the plate when reinstalling it.

If you have any problems with these files, please contact the author at [cbartel@roadrunner.com](mailto:cbartel@roadrunner.com). I will respond as quickly as possible, given that I am retired and unable to do much traveling right now. If your questions are generic in nature and we are able to address the appropriately, we would like to publish the question and answer on the BTOC web site. For privacy, your name will not be printed.