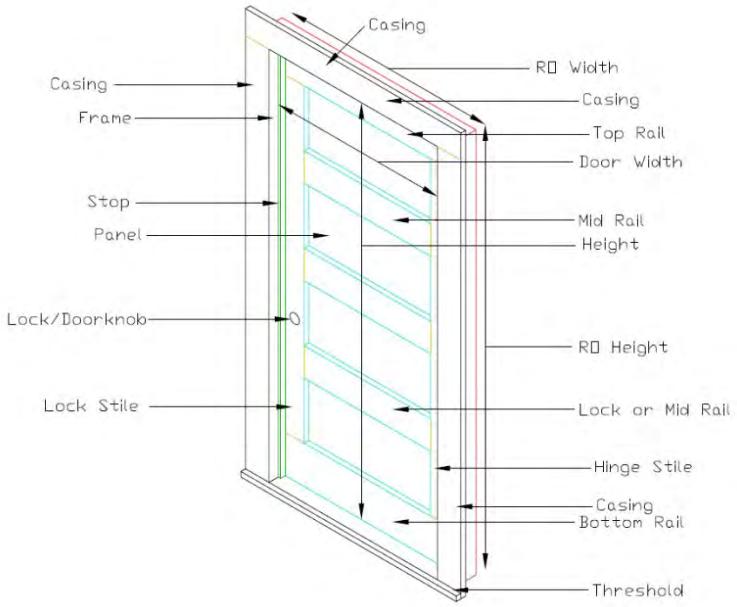
The Anatomy of a Door

I have designed and built many doors on my laser cutter over the years; I've had to learn a LOT about how real-life doors and windows are constructed, both historically and contemporarily. I design all of my doors and windows using prototypical structure, dimensions and proportions as much as I can. There is a lot about how a door or window is constructed that I now take for granted that most modelers never think about; and if you don't know the names of the parts it's very difficult to have a discussion about it.

SO… in this newsletter I bring to you *The Anatomy of a Door*. Let's start by defining the major terms used to describe a door and its parts, then see how a model door is created from a prototype.

The Parts



There are a lot of terms in this picture! Let's look at each of those pieces and figure out what they are.

The door itself is made up of vertical pieces call "stiles" – one on the hinge side, the other on the doorknob side. Until the doorknob side is committed, the door is symmetrical, so you can just call both of them "stiles".

The horizontal pieces are call "rails" – one "bottom rail", one "top rail", and possibly several "mid rails". The rail near the level of the doorknob or lock is called the "lock rail". Again, there's not usually a reason to differentiate between them, so they all are just "rails".

The recessed sections on the door are called "panels". The above example is a "4-panel" door; there are a lot of possible configurations here, including multiple columns – you could have a "2x3 panel door" which would have two panels across and three panels high. As a variant, sometimes panels can be replaced with glass, giving a "glass panel" door.

A prototype door would have three layers (or levels) of material: the front bracing just described, a solid center core layer which appears as the recessed panels, and a back (inside) bracing which is identical to

the front bracing. (When we model these, we usually only model the front bracing and the core door, leaving the back flat.)

IMPORTANT NOTE: A door size is the measurement of the part of the door that opens, and does not include the frame or casing! A typical door might be 36” x 80”, but they can be any dimension that’s needed for the building. The door size, usually in scale inches, is how you would specify a door for new construction.

Moving out and forward, just in front of the door is the “stop”. This is what keeps the door from swinging both directions – what the door closes against.

Moving forward and out again, next is the “casing”. This is a cosmetic surrounding piece that hides any gap between the door from and the wall it’s being mounted in.

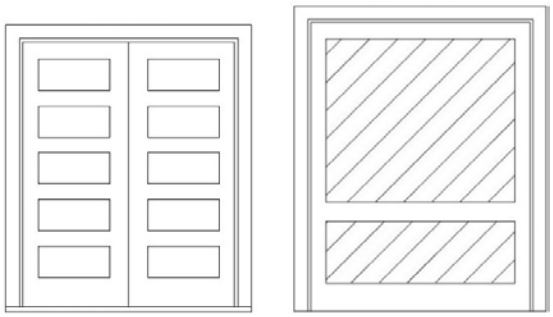
And last is an optional piece at the bottom of the door, the “threshold”. This gives a smooth transition of the door opening to the floor level. Doors opening onto platforms will look best without a threshold; doors to houses and stores probably would look better with one. It’s primarily an esthetical choice.

The next important part of a door is actually a measurement around the back side of the door – the “rough opening” or RO. This refers to the size of the hole needed in your wall that the door frame will smoothly slip into. It will always be larger than the door size and smaller than the overall size. THIS pair of measurements is what you would give to get a door to fit an existing opening.

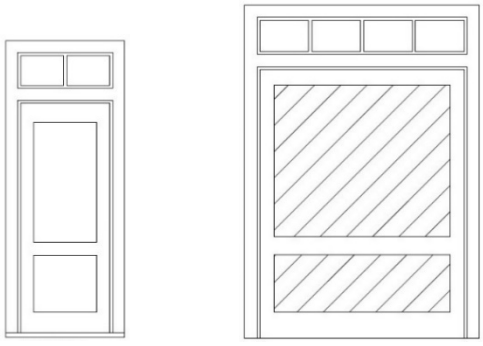
Additional Options

There are several notable options that should be mentioned that also have some unique terminology.

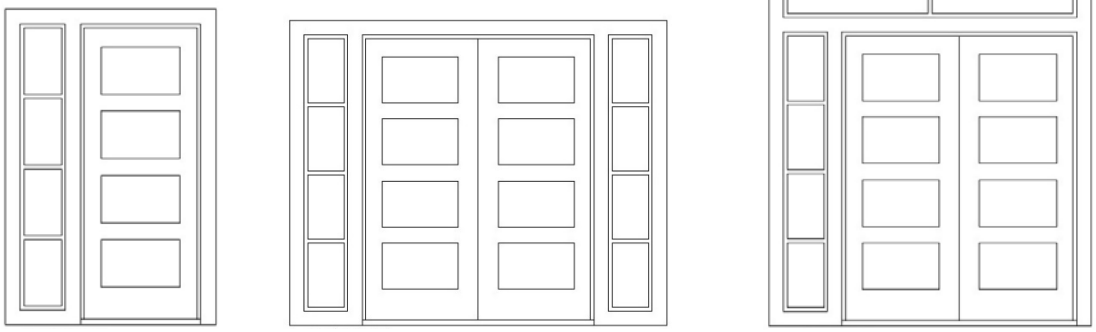
- Types of doors – Besides the standard “single” door discussed so far, double doors, double-wide doors, and “freight” doors should be mentioned. These are mostly self-explanatory except for the “freight” door – that one generally has an extra-deep frame (6”-8”), usually is of plank constructions, and usually slides rather than swings open.



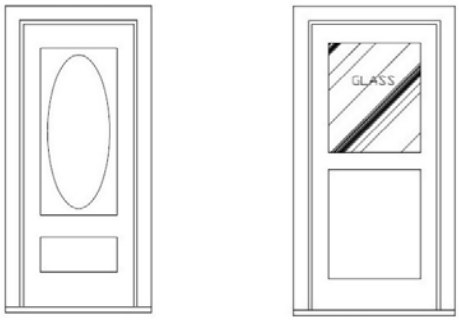
- Transoms – a transom is a narrow horizontal window above the door.



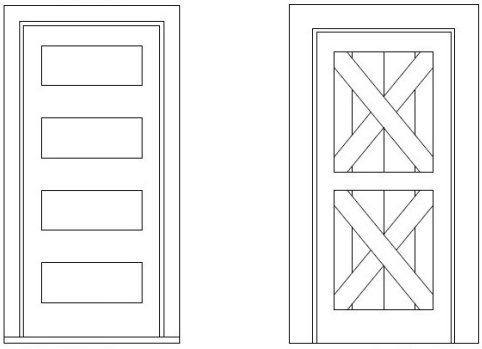
- Sidelights – A sidelight is a vertical window section beside the door, extending the entire height of the door opening. A sidelight could be on either or both sides of the door, and could be either all window panes as shown or a mix of panes and solid panels.



- Doors may have windows within them. Or one or more of the panels could be glass instead of wood.



- The door construction can be a paneled door, or it can be a timbered (rustic) door.



Modeling a Door

I initially model all of my doors in prototype full-size inches, then reduce the model to the desired modeling scale. This has several advantages:

- Gives us a consistent way to spec a door size across scales, including 1:1 scale
- We can use the structure of a prototype door to ensure our model proportions are reasonable and attractive
- We don't have to design a door from scratch for each and every scale

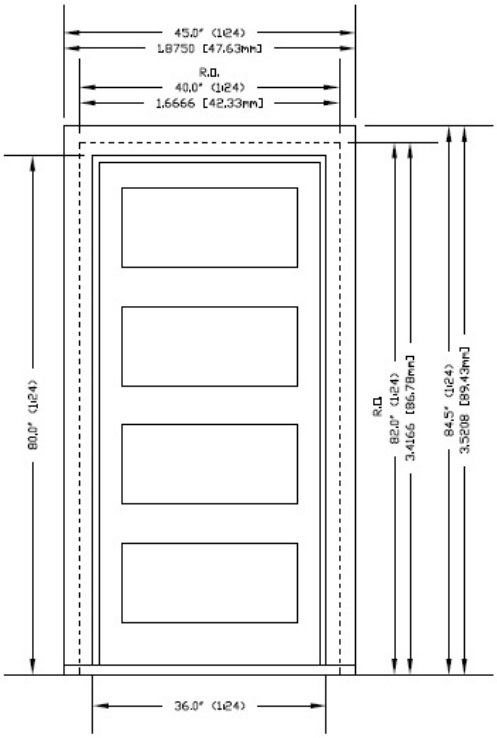
- We can establish a set of “standard specs” that can be applied consistently to all doors. For example, we can make all casings a scale 5” wide, stile 6” wide, bottom rails 12” tall, etc.

The Important Stuff: Given the above, usually all that needs to be specified to get a door designed are:

1) The door dimensions either in scale inches (as discussed above), *or* the RO size in actual decimal inches;
2) The scale of the model (which establishes the dimensions of all of the door pieces – there are 15+ such dimensions and choices in a typical door)

While you can theoretically specify a door size using the “overall dimensions”, this would require using the scale to determine all of the other dimensions. And since the casing width itself is a dependent variable, the resulting door would end up being a non-standard door size with an R.O. size difficult to estimate without doing a complete door design.

The following example shop drawing shows how the door size (scale 36” x 80”), RO size (1.6667” x 3.4166”), and overall size (1.8750” x 3.5208”) apply to a door:



Knowing the *scale* of the door is important because many of the attributes of a door such as the casing width, rail and stile widths, etc, are all standard sizes based upon 1:1 prototype dimensions, and are scaled to the actual size needed for a given scale. If you aren’t a “rivet counter” modeler, then using any close scale will probably look fine to you, but if you’re too far off the door might look “silly” and unrealistic. (For instance, a 1:20 door is 18% larger than the same door in 1:24; putting a 1:20 door in a 1:24 building is probably going to make the building look like a toy.) If you don’t have a specific scale for your railroad, then 1:22.5 might be a good middle-ground to use.

A door could be constructed using a traditional “stick” technique, for my laser-cut models I instead use a layered approach. Each layer is an integral single piece; the multiple layers are stacked together to make the complete three-dimensional door model. For this to work successfully, each layer must be designed so it is a solid unit, and each layer must have an adequate glue-bed on the layers above and below it; this results in a structurally sound final assembly.

Models from one scale cannot just be scaled to create a different scale of the door – this is due to several critical objects that remain constant regardless of scale, such as the kerf (width) of the laser “blade”, the material thickness, and the placement of the parts in the final “kit”. While I start with a 1:1 design initially, that design gets rescaled to each desired version, and then that design gets extensively modified to make it producible and able to be assembled. Truly each scale version of a door is unique.

For repetitious models such as doors and windows that have a large number of “flavors”, I write a program that takes the many parameters and features of all doors and creates a scale-specific version automatically. This has allowed me to add features which used to take days per door and now apply them to all windows from that point on.

Summary

As you can see, there can be almost endless variations of doors. Varying just the composition of the door itself, changing the number and size of panels, adding glass panels or windows, making the door a “rustic plank door with bracing”, or modifying the proportions of the stiles and rails, can provide dozens of unique and interesting doors.

I hope this helps to understand how a door is built, both in a real-life prototype and as a model, and provides a common nomenclature to discuss doors. In a future article I will similarly cover the parts and nomenclature of windows.

Happy Modeling,

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