The Frames

The frame is a rectangular object (think in terms of a picture frame) that sits inside the hive bodies (Figure 1). There are multiple frames per hive body, depending on the width of the hive bodies being used. Mounted inside the frame is the foundation (either wax or plastic) upon which the bees draw out the comb (see picture at right).

If the bottom board, hive bodies and covers are the floors, walls, ceiling and roof of the hive, then the frames are the furniture. The bees live on the drawn frames using them to rear their young and store honey and pollen.

The frames are moveable and can be rearranged within the hive or taken out completely, such as is done when harvesting the honey. A moveable frame is the essence of the modern day hive and makes the management of a bee hive, as we know it, possible. All of this was a result of L. L. Langstroth in 1851, when he devised the “Langstroth” style bee hive - the forerunner of the modern hive - which featured among other things a moveable frame.

Prior to Langstroth’s insight, honey bee colonies were generally destroyed in order to harvest the honey. Needless to say, such practices were not favorable to the bees. With the moveable frame, beekeepers can remove just the frames of honey and leave the rest of the colony intact to live another day.

In addition, the moveable frame allows the beekeeper to inspect the conditions inside a hive, deal with disease and other management challenges, and reuse the comb by putting extracted frames back into the hive. And, of course, the

The standard frame is 19” long. The height depends on the “style” of frame required by the hive body.

<table>
<thead>
<tr>
<th>Type</th>
<th>Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deep</td>
<td>9-1/8”</td>
</tr>
<tr>
<td>Medium</td>
<td>6-1/4”</td>
</tr>
<tr>
<td>Shallow</td>
<td>5-3/8”</td>
</tr>
</tbody>
</table>

The frames can be rearranged within the hive or taken out completely.
modern management of the bee hive contributes greatly to the foundation of current day agriculture which requires vast numbers of colonies migrating around the country for pollination.

Quite an achievement for such a simple device as the frame!

**Frame Sizes**
Frames come in three different heights: deep at 9-18”, medium at 6-1/4” and shallow at 5-3/8” (Figure 2). The size of the frame is determined by the height of the hive body or bodies you are using.

Traditionally, the hive bodies are deeps, so the 9-1/8" frames would be required. However, many beekeepers (including us) are now using mediums, because there is less weight to deal with when lifting and toting a hive body full of honey. And there are a lot of beekeepers who use both (deeps for the brood chamber and mediums for the honey super).

The length of the standard frame is always the same (19”); it is the length of the side bars that makes a frame deep, medium or shallow. Where appropriate, we will provide the dimensions for all three sizes in the plans that follow.

**Basic Construction**
There are five components to a frame; the top bar, two side bars, the bottom bar and the (optional) tack strip (Figure 3). We suggest when building a frame that you start first with the side bars. In particular, the top notch of the side bar must slide snugly into a set of grooves on the top bar. Once you have made the side bars, you can use one as a gauge to adjust the depth of the top bar’s grooves for a proper fit. We will discuss this further in the plans that follow.

When making frames you will not make just one. Hive bodies are designed for 5, 8 or 10 frames each. And you will have multiple hive bodies on a single hive. Making a run of 20, 30, 40 or more frames at a time is not uncommon.

We suggest that you first make a frame or two from beginning to end; you will gain valuable experience doing so. Once you understand what is going on, you will then be able to set-up a frame making operation and crank out a number of frame components at a time.

Also, it is a good idea to make more frames than you think you need. When you need a frame, you need a frame. There will not be enough time to go back to the shop and make more. So always have plenty of frames on hand.

**Frames Need To Be Strong**
The frame probably takes the most abuse of any component of the bee hive. During the life of a frame, it will be pried, twisted, scraped, spun, dropped and generally banged up. Needless to say, the stronger the frame the better it will serve both you and the bees.

One way to achieve strong frames is to select only that portion of the lumber that is knot free. Most of us will be working with “Number 2” grade pine lumber which, by standards, will have knots, splits and other defects. But also by these same standards, number 2 grade lumber should have at least 38% that is free from defects for a length of 30 inches; this percentage is much higher for the length of pieces needed for making frames. We typically will be able to use up to 90% of a board, perhaps even more.

When at the lumber yard, try to select lumber that is as clear as you can find, but don’t worry too much if the pieces you select have knots or other defects. You can simply work around these defects when cutting the lumber to the required lengths. Avoid lumber that is twisted, warped, cupped or crooked.

Another way to achieve strong frames is to make accurate cuts and tight fitting joints. Of all of components in a bee hive, the frame undoubtedly has the most demanding dimensions. In the plans that follow, many dimensions are specified down to the 1/16th of an inch and in some case 1/32 of an inch. These tolerances are important. So you will probably find yourself making test cuts on scrap material and fine tuning the setup. Take you time, be particular, and check your resulting cuts frequently. We will have tips throughout these plans to help you get very accurate cuts.
A Note About Board Sizes
When making the frames, we call for using both “1x” lumber and “2x” lumber. “1x” lumber would be the common sizes such as 1x4, 1x6 or 1x8; these boards are 3/4” thick and typically a half an inch shorter than the second size number. For example, a 1x4 board is actually 3/4” by 3-1/2” (1x8’s are 3/4 inch shy of a full 8 inches wide).

“2x” lumber would be the common sizes such as 2x4, 2x6 or 2x8. These boards are 1-1/2” thick and, again, shorter than the second size number.

In the plans that follow, we will refer to both “1x” boards and “2x” boards. In general, we can cut a board to a specific length and then rip that work piece several times to the required width. For example, for the side bars we can cut a 2x8 to length, cut the top and bottom notches in that block then slice the work piece into multiple pieces. All of the pieces will have exactly the same dimensions of the notches. Quite a time saver.

We leave it up to you to work with the most convenient width. Because we are making multiple parts of the frames, working with wider lumber is generally more efficient and cost effective. If in doubt, start with 1x8’s and 2x8’s and see how it works for you.

Before You Begin...

First, we suggest you read these plans from beginning to end. This will give you a good idea of where you are going. Then we suggest you make a frame or two. This will help you understand each step and how everything comes together. Then you can go back and ramp up your operation and really start to crank out a lot of frames.

Also, with frames you will be making a lot of fairly small parts and close cuts. Always think safety first. We strongly recommend that you have a pair of push sticks on hand and ALWAYS use them when working with the table saw. In Appendix 2, we provide a scaled template from which you can make your own push sticks. Or you can purchase a set commercially.

We will also make use of other shop aids, such as a tenon jig and a taper jig. Other shop plans in our series contain instruction on how to make these. Check out the references at the end of these plans.

Bee smart. Stay focused. Bee safe.
Construction Details: The Side Bar

The side bar is 3/8" thick and ranges from 9-1/8" to 5-3/8" long (Figure 4 and Table 1). The top section ("A") is 1-3/8" wide and then narrows down to 1-1/8" wide on the lower section ("B"). Down the middle are a series of small holes (3 or 4 depending on overall height) that are used to pin wax foundation. These pin holes are not needed for plastic or "duragilt" foundation.

At the top of the side bar is a notch 7/8" wide and 7/16" deep that will slip into grooves on the top bar. On either side of this notch are 1/4" wide tabs.

On the bottom of the side bar is another notch that is 3/4" wide and 3/8" deep. This lower notch is for the bottom bar. The tabs on the lower notch are 3/16" wide.

We use a dado blade to make these notches. Cutting these notches in stock that is 3/8" thick is not particularly easy or safe. Instead, we make these dado on the ends of a much larger piece of "2x" stock, such as a 2x8.

Once both the top and bottom notches are made in the 2x, you can then cut the stock into 3/8" thick "slices". This approach is much safer and will yield multiple side bars from the one piece of stock (see Table 2).

Table 1. Side Bar Heights

<table>
<thead>
<tr>
<th>Length “A”</th>
<th>Deep</th>
<th>Medium</th>
<th>Shallow</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-1/2&quot;</td>
<td>2-5/8&quot;</td>
<td>2-1/8&quot;</td>
<td></td>
</tr>
<tr>
<td>5-5/8&quot;</td>
<td>3-5/8&quot;</td>
<td>3-1/4&quot;</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>9-1/8&quot;</td>
<td>6-1/4&quot;</td>
<td>5-3/8&quot;</td>
</tr>
</tbody>
</table>

At the top of the side bar is a notch 7/8" wide and 7/16" deep that will slip into grooves on the top bar. On either side of this notch are 1/4" wide tabs.

On the bottom of the side bar is another notch that is 3/4" wide and 3/8" deep. This lower notch is for the bottom bar. The tabs on the lower notch are 3/16" wide.

We use a dado blade to make these notches. Cutting these notches in stock that is 3/8" thick is not particularly easy or safe. Instead, we make these dado on the ends of a much larger piece of “2x” stock, such as a 2x8.

Once both the top and bottom notches are made in the 2x, you can then cut the stock into 3/8" thick "slices". This approach is much safer and will yield multiple side bars from the one piece of stock (see Table 2).

Table 2. Number of Side Bars From Width of “2x” Stock

<table>
<thead>
<tr>
<th>Width of “2x” Stock</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>2x4</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>2x6</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>2x8</td>
<td>14</td>
<td></td>
</tr>
</tbody>
</table>
**Construction Details: The Side Bar**

**Step 1. Side Bar: Make the top and bottom notches**

From “2x” stock (we will use the example of a 2x8), cut a piece to the length of the top bar (see Table 1). Avoid any knots or defects in the lumber; only use clear sections.

“2x” stock is 1-1/2” wide and the side bar is 1-3/8” wide. We have to allow for the extra 1/8 inch of the “2x” (Figure 5). This extra 1/8 inch will be trimmed in a later step. In the drawings, we show the side that will be trimmed on the left; notice that the upper left tab is 3/8 inch (1/8 inch wider than the right tab at 1/4 inch). In order to avoid confusion, we recommend that you strike a line on the side of the “2x” board that will be trimmed.

For the top notch, use a dado blade raised to 7/16 of an inch. The width of the dado set is up to you; we use the dado blade set for 3/8”. Anything wider labors the saw as a lot of material is being removed. Anything narrower increases the number of passes needed to make the full 7/8 inch width.

Adjust the fence to a 1/4 inch from the inside of the dado blade. You may want to make a test cut on a scrap piece of “2x” to check the depth and 1/4 inch spacing.

After you make the first cut on the first piece of stock, repeat this same cut on all of the other pieces of stock you have cut to length for the side bars.

Then move the saw’s fence further to the right a bit less than 3/8 inch and repeat the cut on all your pieces. The notch will now be wider, but not yet at the required 7/8 inch.

For the third pass, move your fence so that there is 7/8” from the fence to the outside of the dado blade. Double check that the final width is 7/8” by making a test cut on a piece of scrap. It is better to make several passes to “sneak” up on the 7/8 inch width than to overshoot and end up with something wider.

For the bottom notch, flip the “2x” stock over and basically do the same thing again. This time, start with the fence 5/16” from the inside of the dado blade set to a 3/8” height (again make a test cut). Sneak up on the 3/4 inch width. You can use a scrap piece of 1x4 (which is 3/4 inch wide) to test the width; it should be snug.

When completed, you should have a number of pieces of “2x” stock at the correct length and with a notch on the top end and a notch on the bottom end (Figure 6).
**Step 2. Side Bar: Cut the 2x Stock into 3/8” Slices**

Using a standard blade in your table saw, set the fence 3/8 inch from the inside of the blade. From each piece made in Step 1, cut a series of 3/8” slices (Figure 6).

Before making the slices, you may want to make a reference mark to indicate which is the top notch and which is the bottom notch. Getting them confused is easy to do. We usually take a felt tipped pen and strike a line down the inside of the top notch before cutting the block.

**Shop Tip**

Always use push sticks when making this type of cut on the table saw (See Appendix 2). Push sticks will keep your fingers away from the blade and help hold the work piece securely during the cutting operation.

**Step 3. Side Bar: Trim the Wide Side**

As mentioned before, the side bars made from “2x” stock will initially be 1/8 inch too wide on one side. In this step, we will trim the side bar to 1-3/8 inches (Figure 7).

Before doing this, we like to take a moment and organize all of our pieces into stacks; there could be a lot of them. Make sure that the marked sides are all on the same side of the stack and the top notches are all on the same end of the stack. If you trim the wrong side, the piece will be waste.

Set the table saw fence 1-3/8 inches from the inside of the blade. Make a test cut to make sure the setup is correct. When completed, each tab of the upper notch will be 1/4” wide and the bottom notch tabs will be 5/16” wide.

**Side Bar, Step 2:** Using a table saw, cut the 2x into 3/8” slices.

**Side Bar, Step 3:** On each 3/8” “slice” done in the previous step, trim to final width of 1-3/8”. Cut 1/8” from the “marked” side of the piece (shown here on the left). Be sure you cut on the correct side. When completed, the top tabs will each be 1/4” wide and the two bottom tabs will each be 5/16” wide.
Step 4. Side Bar: Trim Lower Section to Width

The lower section of the side bar now needs to be trimmed to the 1-1/8 inch width. This involves removing a 1/8" strip from either side of just the lower section (Figure 8).

We find it easiest to make this cut on the band saw. A table saw is awkward and won’t leave a satisfactory end. You could also use a jig saw or even a router table.

We like to strike a reference line at the top of the bottom section (see Table 1) that will mark the end of the cut. This reference line needs to be on both sides of the work piece.

We set the fence on the band saw for a 1-1/4 inch cut to the inside of the blade. Make sure the setup is correct. The width of the bottom tabs should be 3/16 inch; not much room for error here (see photo, top right).

With the band saw properly set, we make the cut on one side of the work piece and then flip it over and make the cut on the other side. Both cuts stop at or just shy of the reference line.

To make the flared transition to the top section, we again use the band saw and just “eyeball” the 45 degree cut (see photo, lower right).

Step 5. Side Bar: Drill the Pin Holes

The next step is to drill the pin holes used when installing wax foundation. If you are using plastic or duragilt foundation, you may skip this step. The pin holes are centered vertically down the middle of the side bar (see Figure 4). The number of pin holes is up to you. Three or four for deeps and fewer for medium and shallow frames.

We use a 7/64” drill bit, but your pins may need a different diameter. Use whatever works for you.

Step 6. Side Bar: Sand Rough Edges

Finally, it is time to clean up any rough edges. A drum sander attached to a drill press makes short work of this step, but hand sanding works too.

When sanding, inspect each side bar. Reject any that don’t fit the spec (if you are like us, there will be some) or have knots or splits that will weaken the piece.
Construction Details: The Top Bar

The top bar, as the name implies, is the top most piece of the frame (Figure 9). The top bar spans the entire length of the hive body and sits on a ledge, called the frame rest, at the top of the hive body.

The top bar is 19" long, 1-1/16" wide and 3/4" high. It is made from “1x” stock. You need to avoid knots and defects in the wood, so you will want to work with clear sections within the board. We like to use 1x8 lumber since we can get 5 top bars from one 19" long board (see Table 3).

There are two different styles of top bars: the wedge (used with wax foundation) and the grooved (used with plastic or duragilt foundation). The difference lies in how the foundation is inserted into the top bar. With the grooved style, a simple groove (or dado) runs the length along the bottom of the top bar. The foundation slips into this groove.

With the wedge style, the outside piece of the top bar which forms the groove is removed. A tack strip is then nailed back onto the top bar when installing the foundation.

These plans include the step necessary to make the wedge style top bar. If you are making grooved top bars, you will skip this step.

Each end of the top bar, the part that sticks out from the side bars, is called the “ear”. The ear has a few subtle features that help when prying the top bar out of the hive body. First, the lower part of the ear is slightly tapered (when viewed from the side; see Figure 9). Second, the corners of the ears are beveled (when viewed from the top; see Figure 9). Making both of these features will be covered in the steps that follow.

Table 3. Number of Top Bars From Width of “1x” Stock

<table>
<thead>
<tr>
<th>Width of “1x” Stock</th>
<th>Number of Top Bars</th>
</tr>
</thead>
<tbody>
<tr>
<td>1x4</td>
<td>3</td>
</tr>
<tr>
<td>1x6</td>
<td>4</td>
</tr>
<tr>
<td>1x8</td>
<td>5</td>
</tr>
</tbody>
</table>

The top bar spans the length of the hive. The ends of the top bar that protrude past the side bars are called the “ears”. The ears rest on the hive body’s frame rest and have several features that help when removing the frame from the hive body.
Step 1. Top Bar: Cut the Work Piece to Length
From “1x” pine cut a piece 19” long, 1-1/16” wide; it will be 3/4” high (Figure 10).

Step 2. Top Bar: Cut Center Groove
Using your table saw, create a groove (dado) down the length of the work piece (Figure 11). Set the fence 1/2 inch from the inside of the blade and raise the blade to a 1/4 inch. The width of the groove will be the width of the standard blade that you use on your saw; do not use a dado blade for this cut.

Make this groove on the bottom of all of your top bar work pieces.
Step 3. Top Bar: Cut the Side Bar Grooves

On both sides of each end, we need to cut a shallow groove (dado) 5/8 inch from the end (Figure 12). This dado is 3/8 inch wide and 3/32 inch deep. The critical dimension is the 7/8 inch between the bottoms of the two dados. It is this dimension that matches the width of the top notch on the side bars (Figure 4).

To make this cut, use a dado blade set for a 3/8 inch wide cut. Adjust the height of the blade to 3/32 inch. Then move the fence of the table saw 5/8" of an inch from the inside of the dado blade. You can then place the end of the work piece against the fence with the miter gauge and make the cut.

Getting the depth of the dados to 3/32 inch is not particularly easy. You will definitely want to make a series of test cuts on a scrap work piece to get it right. One way to test the depth of the cut is to put a 3/32" drill bit in the groove and then span the groove with the edge of your combo square. The drill bit should be snug against the square with no “wiggle” room.

A second, and probably more important, test of the setup is to take a sample side bar (which you have already made) and see if the top notch slips into the grooves. The side bar should be snug.

To make the grooves, slide the end of the work piece up against fence, use the miter gauge to keep the piece square to the blade, and slide the piece through. Then flip the work piece over and cut the other side. Make these grooves on both ends of the work piece.

Step 4. Top Bar: Cut the Lower Dado

The next step is to cut another 3/8 inch wide dado on the bottom of the work piece (Figure 13). This dado is also 5/8 inch from the end, so do not move the fence position used in Step 3, above. Adjust the height of the dado for a 1/4 inch cut.

To cut the bottom groove, slide the end of the work piece up against fence, use the miter gauge to keep the piece square to the blade, and slide the piece through. Be sure to make the cut on the bottom of the work piece (the side with the long groove). Make this dado on both ends of the work piece.
**Step 5. Top Bar: Create the Tapered End**

Each end of the top bar has a tapered bottom which goes from 7/16 inch on the end to 1/2 inch on the outside edge of the bottom dado, a distance of 5/8 inch (Figure 14).

The taper is quite subtle; if you are uncomfortable in making it you can certainly live without it. It is, however, a nice feature and worth taking a stab at it.

**Using a Band Saw to Make the Tapered Ear**

The secret is the taper jig set at the proper angle. As mentioned above, the taper goes from 7/16 inch to 1/2 inch over a distance of 5/8 inch. This is a difference of 1/16 inch over a length of 5/8 (or 10/16ths) of an inch. Saying the same thing in another way, the taper has a rise over run of 1 to 10.

Using this ratio, we can set the spread on the taper jig. Measure 10 inches along the back side of the jig from the hinged end. Then spread the outer arm of the jig so that there is a 1 inch gap between the two sides at this point. The jig now has a rise over run of 1 to 10.

On the side of each top bar end strike a line 7/16 of an inch from the top. This marks the location of the beginning of the cut. With the top of the side bar against the taper jig, adjust the jig and the top bar to start the cut at 7/16 inch (see photo, lower right). Then slide both jig and top bar through the saw making the tapered cut; the taper should just at the bottom of the lower dado.

**Using a Table Saw to Make the Tapered Ear**

You can also make the tapered ear on the table saw. Rotate the blade to an angle of 5 degrees. Adjust the height of the blade to 5/8th inch. Install your tenon jig and move the fence so that there is 7/16th inch from the jig to the bottom of the blade (where it comes through the insert).

Clamp the top bar with the bottom facing out to the tenon jig and square to the table. A backstop on the back end of the tenon jig helps keep the top bar square to the table (see photo below).

**Photo Captions:**

(Top) The taper jig on the band saw. The jig is set for a rise over run of 1 to 10.
(Bottom) Close up of cutting the taper on the band saw.

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**Shop Tip**

To make a taper jig, see “In the Beekeeper’s Workshop” plans for “Making Hive Top Ventilation Shims”.

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**“In the Beekeeper’s Work Shop”**

*Building a Bee Hive: The Frame*

© by Stephen E. Tilmann
Step 6. Top Bar: Create the Beveled Corners
Another subtle feature of the end of the top bar is the beveled corners (Figure 15). As with the bottom taper, the beveled corners makes taking the frames out of the hive a bit easier.

The corners of each ear are cut at a 45 degree angle. All you really have to do is soften the corners a bit; a properly cut bevel will result in a face that is a 1/4 inch wide.

To make this bevel with a table saw, we install a sacrifice board against the fence (see photo, top right). Move the fence so that the blade just clears the sacrifice board (see photo, bottom right). You will have to make a few test cuts to find the right spacing for your blade.

With a thin kerf blade on our table saw, as shown in the photos, the sacrifice board just clears the blade. If you have a wider kerf blade, then you may have to lower the blade below the table, move the fence so that the sacrifice board is slightly over the blade and then raise the blade while the saw is running to make a pocket.

Set the miter gauge to a 45 degree angle, place the top bar so that it touches the sacrifice board ahead of the saw blade and then run it through (see photo, bottom right). Cut the bevel on both corners of both ends (four cuts in total).
**Step 7. Top Bar: Cut Out Tack Strip Space**

The last operation on the top bar is to remove part of the bottom that forms the center groove made in step 2. Note, however, that this step is only done on "wedge" style frames. If you are making "grooved" frames, do not do this operation.

Compare Figure 15 (from step 6) to Figure 16 (this step). Note in the figure that the lower right side of the work piece has been removed. This is the place where the tack strip will go when installing foundation. The part that remains is 1/2 inch wide and 1/4 inch high (Figure 16). The center groove that was cut in Step 2 is probably around 1/8 inch wide. Therefore the piece that we are removing is around 11/16 inch wide and 1/4 inch high.

To make this cut, adjust the height of the table saw blade to 11/16 inch; the blade should be just below the remaining 1/2 inch back. Then move the fence 1/2 inch from the inside of the blade. The top bar is cut with the top against the fence and the section that is being removed toward the bottom.

Make a test cut. The cut should not encroach on the ear's bottom taper. Also insert a side bar to check for fit.

It is very easy to make this cut on the wrong side of the top bar. We like to organize the work pieces beforehand into stacks, placing each top bar in the position they will be when put on the saw (on edge, cut side down, top to the right). Double check the work pieces before you start.
Construction Details: The Bottom Bar and Tack Strip

Both the bottom bar and tack strip (Figure 1) are relatively easy to make. The bottom bar can be made from “1x” stock as it is 3/4 inch wide. The tack strip can also be made from “1x” stock. Note, the tack strip is not required if the top bar is of the “grooved” style.

The bottom bar is 17-3/4” long, 3/4” wide and 3/8” high and features a 5/16” deep groove centered along the entire length (Figure 17). It is made from “1x” stock. You need to avoid knots and defects in the wood, so you will want to work with clear sections within the board. We like to use 1x8 lumber since we can get up to 15 bottom bars from one 17-3/4” long board (see Table 4).

Table 4. Number of Bottom Bars From Width of “1x” Stock

<table>
<thead>
<tr>
<th>Width of “1x” Stock</th>
<th>Number of Bars</th>
</tr>
</thead>
<tbody>
<tr>
<td>1x4</td>
<td>7</td>
</tr>
<tr>
<td>1x6</td>
<td>11</td>
</tr>
<tr>
<td>1x8</td>
<td>15</td>
</tr>
</tbody>
</table>

The tack strip is also easy to make. It is 7/16” wide, 1/4” high and 17” long (Figure 19). From a 17” long piece of 1x8 stock, you should be able to get up to 19 tack strips (see Table 5).

Table 5. Number of Tack Strips From Width of “1x” Stock

<table>
<thead>
<tr>
<th>Width of “1x” Stock</th>
<th>Number of Strips</th>
</tr>
</thead>
<tbody>
<tr>
<td>1x4</td>
<td>9</td>
</tr>
<tr>
<td>1x6</td>
<td>14</td>
</tr>
<tr>
<td>1x8</td>
<td>19</td>
</tr>
</tbody>
</table>

**Step 1. Bottom Bar: Cut the Work Piece to Length**

From “1x” pine cut a piece 17-3/4” long, and 3/8” wide (Figure 17). To make the cut, set the fence 3/8” from the inside of the blade. Note that the work piece may be subject to being kicked back with some force, so stand to the side when making the cut. To avoid kick back, see the technique explained in Appendix #1 at the end of these plans.

**Step 2. Bottom Bar: Cut the Centerline Groove**

On the table saw, adjust the blade to 5/16” height. Adjust the fence so that the blade will run down the center of the work piece (Figure 18). The middle of the blade will be 3/8 inch from the fence. Then cut the groove. Notice that only about 1/16” of an inch of wood will be left at the bottom of the groove. This is not very much wood, which is why the accuracy when setting up the saw cuts is important.
Step 1. Tack Strip: Cut the Tack Strip to Length
From “1x” pine cut a piece 17” long, and 1/4” wide (Figure 19).

Step 2. Tack Strip: Cut the Tack Strip to Width
For each work piece you cut to length in the previous step, you need to cut to the 7/16” width.

Set the fence 7/16” to the inside of the blade and then make your cut. To hold the work piece firmly against the table and to avoid throw back, we strongly advise using push sticks. See Appendix #2 at the end of these plans on how to make a set of push sticks.

Construction Details: Assembling the Frame

We can now assemble the frame. For each frame, dry fit all of the pieces to make sure everything fits. If you run across a piece (or more likely a few pieces) that are tight, you might have to use some sandpaper to correct. Also, now is a good time to do the final inspection and reject any work piece that is unsatisfactory.

The strength of the frame comes from the glue used to hold all of the pieces together. The staples and brads basically hold everything together until the glues sets up. We use Franklin’s Exterior Tight Bond which we find easy to use and does a good job.

When applying the glue, use a glue brush and make sure both surfaces of the work pieces are fully covered. Voids in the glue weaken the joint.

Also, use a rafter square (a small aluminum square) to make sure the side bars are square to the top bar. A single 1” staple through the each end of the top bar and into the side bar is sufficient (Figure 20). Similarly, a 3/4” staple up through the end of the bottom bar into the side bars is good enough.

Finally, a 1” staple at the top of the side bar tucked up under the ear and into the top bar will add a bit more strength.

References:
For plans & video on building other hive components, go to www.michiganbees.org and search for “workshop”.

www.beesource.com/build-it-yourself/

Bee Equipment Essentials by Ed Simon, Wicwas Press.

Revision History:
8/12/14: original version
1/29/14: Revised Top Bar, Step 5
“In the Beekeeper’s Work Shop”
Building a Bee Hive: The Frame
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List of Materials: Frame

WOOD
A  Side Bars (2)  3/8 x 1-3/8 – 9-1/8  5
B  Top Bar (1)  3/4 x 1-1/16 – 19  8
C  Bottom Bar (1)  3/4 x 3/8 x 17-3/4  17
D  Tack Strip (1)  1/4 x 7/16 x 17  19

HARDWARE
1” staples, brads or nails for assembling frame
3/4” staples, brads or nails for assembling frame
Franklin’s Titebond® Glue

Note: Sizes shown for frame used in standard deep hive body.

You can use the following two tables as a guide to the approximate number of components obtainable from standard 8 foot long board. The yields assume a 100% clear board; deductions will have to be made for working around defects such as knots and splits.

Approx. Nbr of Components From 8-Foot “1x” Board

<table>
<thead>
<tr>
<th></th>
<th>Top Bar</th>
<th>Bottom Bar</th>
<th>Tack Strip</th>
</tr>
</thead>
<tbody>
<tr>
<td>1x4 - 8'</td>
<td>15</td>
<td>35</td>
<td>45</td>
</tr>
<tr>
<td>1x6 - 8'</td>
<td>20</td>
<td>55</td>
<td>70</td>
</tr>
<tr>
<td>1x8 - 8'</td>
<td>25</td>
<td>75</td>
<td>95</td>
</tr>
</tbody>
</table>

Approx. Number of Side Bars From 8-Foot “2x” Board

<table>
<thead>
<tr>
<th>Frame Height</th>
<th>Deep</th>
<th>Medium</th>
<th>Shallow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work Pieces Per 8’ Board</td>
<td>10</td>
<td>16</td>
<td>26</td>
</tr>
<tr>
<td>Board Used</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2x4 - 8’</td>
<td>70</td>
<td>172</td>
<td>182</td>
</tr>
<tr>
<td>2x6 - 8’</td>
<td>110</td>
<td>176</td>
<td>286</td>
</tr>
<tr>
<td>2x8 - 8’</td>
<td>140</td>
<td>224</td>
<td>364</td>
</tr>
</tbody>
</table>
Photo Captions:
1. Detail of the top bar’s “ear”.
2. The bottom bar showing the centered groove.
3. Using a drill bit to measure the height of a dado blade.
4. Two completed side medium side bars.
5. Cutting transition between lower and upper sections of the side bar.
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Building a Bee Hive: The Frame
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Appendix #1: Cutting Thin Strips

Rule #1 in the shop is to operate your tools safely. Almost any shop tool can quickly turn a good day into a not so good day. It is unfortunate that too many people figure this out the hard way.

Making frames involves the table saw and cutting thin pieces from your work stock. These are two prime ingredients for shop drama. When making cuts with a small distance between the saw blade and the fence, the work piece is subject to rather forceful “kick back”. The thin work piece can come shooting back out of the blade with considerable vigor. I have had work pieces penetrate the wall over 10 feet away as a consequence of kick backs.

Kick backs of this sort are caused when the work piece becomes pinched between the blade and the fence. One way to avoid these types of kick backs is to cut the stock so that the thin piece is on the outside of the blade. When the cut is complete, the thin piece simply falls away from the blade. Since there is nothing to pinch the piece against the rotating blade, there is no kick back.

One problem in making thin cuts on the outside of the blade is setting the width for each repetitive cut. The idea is to have each piece the same thickness, and trying to adjust the fence with a ruler each and every time just doesn’t work.

Here is a tip which you can easily set the correct thickness when cutting repetitive thin pieces off of a wider piece of stock. In the plans for the frame, you would be making this type of cut when “slicing” off the side bars from the “2x” stock (step 2 of the side bar), and when cutting the bottom bars (step 1 of the bottom bar) and the tack strips (step 1 of the tack strip).

Step 1. Appendix #1: Use a Combo Square
The trick is to use a combo square (a small metal square with a sliding metal ruler) and a tight fitting wood strip in the left hand miter gauge track (see photo, below). I use a 3/4-inch oak strip with absolutely no wiggle when in the track.

Step 2. Appendix #1: A Drill Bit as a Spacer
The next step is to drop in a drill bit of the proper diameter between the base of the square and the wood strip (see photos, below). For example, the bottom bar of the frame is 3/8 inches. So drop in a 3/8th inch drill bit. Drill bits are a very accurate measure for width.
Appendix #1: Cutting Thin Strips (cont’d)

**Step 3. Appendix #1: Adjust Ruler Against Kerf**
Now loosen the ruler and slide the end up against the saw blade’s kerf (see photo, below). If the blade has alternating kerfs then measure to the kerf closest to the ruler (ie, the lefthand side of the blade). Tighten the ruler at this spot. Really tighten the ruler; you don’t want the ruler to slip when making you cuts.

**Step 4. Appendix #1: Ruler to Blade Spacing**
When you remove the drill bit and push the combo square’s base up against the wood strip, the distance between the end of the ruler and the outside of the blade is exactly the diameter of the drill bit (see photo, below). In our case, 3/8ths of an inch.

**Step 5. Appendix #1: Cutting the Work Piece**
Once the combo square is setup, we can now begin to cut our work piece. Move the combo square to just in front of the blade, put the stock against the fence and adjust the fence so that the stock butts up against the end of the ruler (see photo, below). The part of the stock on the outside of the blade is exactly the thickness of the drill bit’s diameter.

**Step 6. Appendix #1: Make Repetitive Cuts**
Once the first piece is cut, it is just a matter of repeating the last step. Each “slice” will be exactly the same thickness; and no danger of kick back.

**Shop Tip**
Use a “zero clearance” insert (as shown in the photos) when cutting thin pieces. These inserts will prevent the pieces from falling down into the blade well, which will create a drama scene on its own of a different sort.
Appendix #2: Push Sticks

A push stick is essential equipment in our shop and should be in any shop with a table saw. Push sticks are short, wood handle-like gadgets with a notched end (see photo, right). They are used to hold your work piece securely down and against the fence when making cuts with a table saw. Push sticks allow you to not only hold the piece securely, they keep your fingers well away from the saw’s blade.

We use push sticks when working with the table saw all the time (literally). And in particular, we cannot conceive of making thin cuts without a push stick or two. We are very fond of our fingers right where they are.

We have two sizes of push sticks and use them both. One is 14 inches long made out of scrap 3/4” stock (ie, a 1x4). The other is a bit shorter, at 10 inches, and thinner at 1/4 inch.

Commercial push sticks are available or you can make your own. For those who want to make their own, we have included in these plans a template for making push sticks. If you don't have any push sticks, then we highly encourage you to take the time and make a set.

All of the nicks at the bottom of ours remind us of those times when it would have been our fingers, rather than the push sticks, that got just a little too close to the saw’s blade.
Appendix #2: Push Sticks (Template for 14” and 10”)

Notes:
1) All drawings are at half scale (1 grid = 1/2 inch)
2) 14-inch push stick (left) is 3/4 inch thick (made from a 1x4)
3) 10-inch push stick (right) is 1/4 inch thick.
4) Transfer template to full scale or print the drawings at 200%.
5) Sand edges for comfort.