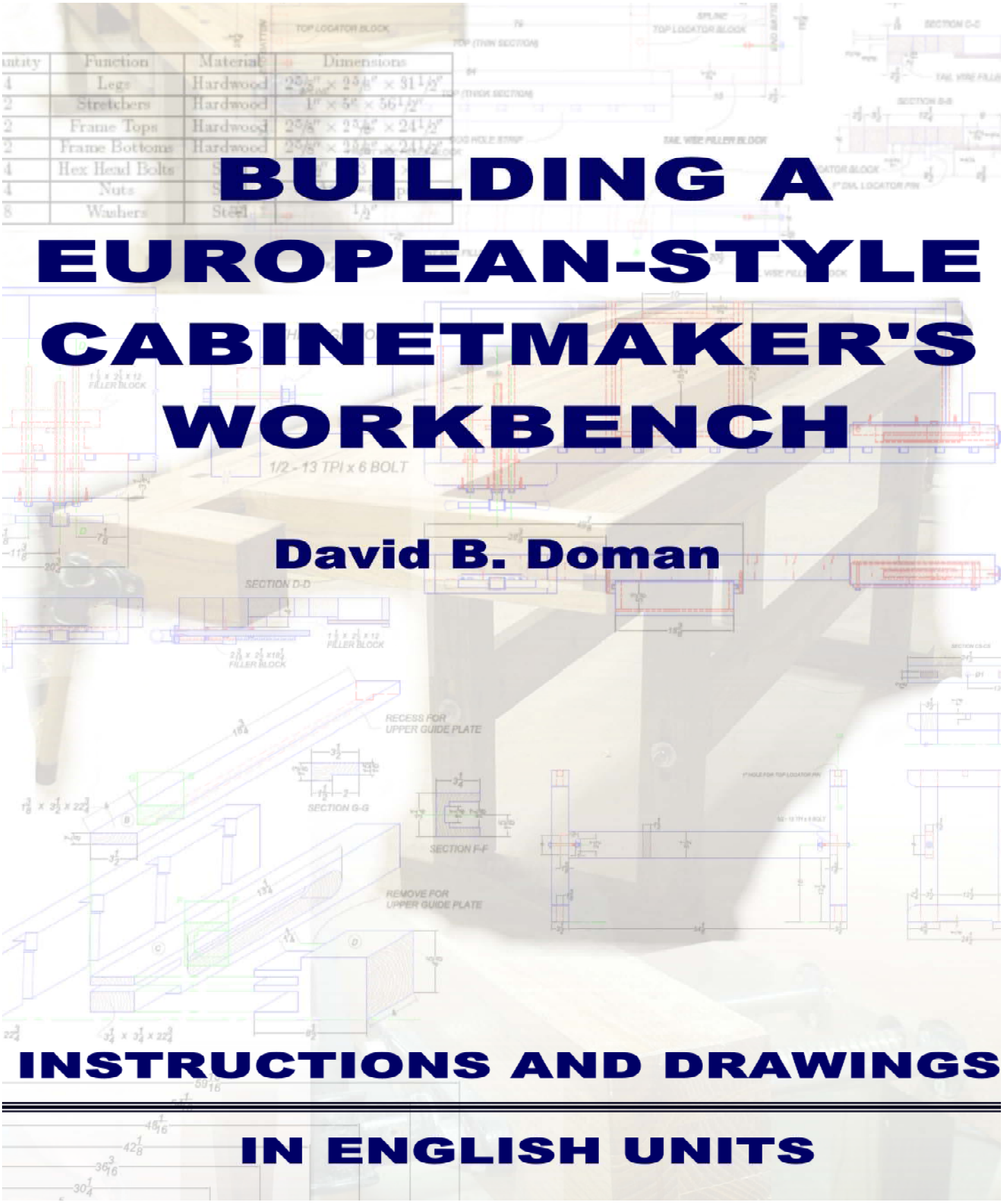

# BUILDING A EUROPEAN-STYLE CABINETMAKER'S WORKBENCH

David B. Doman

## INSTRUCTIONS AND DRAWINGS

## IN ENGLISH UNITS

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# Building a European-Style Cabinetmaker's Workbench

## Instructions and Drawings in English Units

David B. Doman*

December 19, 2007

*This eBook can be purchased at www.isobevel.com/workbench.htm, thank you for your support.

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# 1 Introduction

Different cultures have developed and refined workbenches for many purposes over the course of thousands of years. A particularly useful design for fine woodworking is the European style of bench. An example of such a bench is shown in Figure 1. A European bench typically includes both a front vise and a tail vise. Tail vises are used in conjunction with work holding devices called benchdogs. Benchdogs vary in design and can take the form of square or round pegs that are pressed against the workpiece to secure it to the bench. One dog is placed in a hole in the bench, while another is placed in the tail vise. The tail vise is then moved using a benchscrew to close the distance between the dogs until the workpiece is secured to the bench.


Figure 1: A finished workbench; black locust top on a pressure treated lumber trestle

The bench described in this book is similar in form and dimensions to the commercially available Ulmia Master Cabinetmakers Workbench. I built my bench based upon drawings made by E. Carlyle Lynch for the Woodcraft Supply Corp. Mr. Lynch reportedly made his drawings by carefully measuring an Ulmia bench. In this document, I have prepared all new drawings using a computer-aided-drafting package. In a number of cases, I have replaced difficult to obtain material sizes with material that is more widely available. I have also changed the drawings to reflect the vise hardware that I used on my own bench which differs from that on the Lynch drawings. Some plans for jigs have been provided that will help speed the process of building the bench. You will find that the drawings and detail views are dimensioned rather profusely and in the unlikely event that you require a dimension that has not been explicitly written, the drawings will print to the scale listed in each caption. You can therefore measure directly from the drawings. When printing the document from Acrobat, make sure that you do not select a print option that distorts the scale of the drawings; otherwise, the captions will not correctly reflect the drawing scale. The document is designed to be printed on letter size paper.

Workbench design and construction presents many opportunities for customization and personal statement; therefore, there may be places where you may wish to depart from the plans that I present. I would also suggest that you borrow a copy of "The Workbench Book" [1] from your local library before starting on your own bench. There, you will find many helpful hints and ideas that you may decide that you want to incorporate.

# 2 Wood Selection

It is generally agreed that the workbench top should be constructed of well seasoned, close-grained hardwood. Your choice of wood will most likely depend upon cost and availability. The commercially available Ulmia benches are made from European Beech. My bench was constructed from Black Locust, which is one of the hardest and most dense woods in North America. A survey of bench tops from [1] shows that hard maple, black walnut, and beech have been used with success.

Depending upon availability, you can choose between air-dried lumber or kiln-dried. The moisture content of kiln-dried lumber is typically 8% - 10%. If you use air-dried lumber, be sure that it is seasoned at least 1 year per inch of thickness. Air-dried lumber is not as prone to honeycombing or checking as kiln-dried; however, the moisture content of air-dried lumber will usually be higher.

Table 1 is presented to provide you with information to help you choose wood for your workbench, based upon what is available in your area. Some key measures to consider include density, modulus of elasticity, impact bending, and hardness. In these categories, higher numbers are better in terms of workbench strength and durability. Unfortunately, these properties can also make woodworking and machining difficult, so before you make a final decision on the wood that you will use for your bench, obtain a sample to make sure that you can live with that choice throughout the project. Low values of volumetric shrinkage are desirable and values are provided in the table for your information. A brief explanation of the material properties are in order:

- The modulus of elasticity is a measure of a material's stiffness or resistance to bending.
- Impact bending is a measure of the material's ability to absorb shocks without bending beyond the proportional limit (i.e. entering the nonlinear region of a stress-strain curve). The test is conducted by dropping a hammer of a fixed weight onto a beam until the beam ruptures or deflects beyond some maximum allowable value. The numbers in the table indicate the drop height of such a hammer.
- Hardness is an important parameter for a workbench top because it is a measure of resistance to indentation. The numbers in the table represent the results of Janka hardness testing, where a $0.444''$ ball is pressed into the side of a wood sample to a depth of $0.222''$. The force required to push the ball into the wood is then used as the measure of hardness.
- Volumetric shrinkage numbers given in the table represent how much the volume of a green wood sample is reduced when it is oven-dried to near 0% moisture content. Lower numbers are desirable.

While these are important measures, grain texture and the ability to be shaped by machine and hand tools are other factors to consider. Note that American Beech is the first entry in the table and is intended to be used as a baseline for comparison to other woods when you are making your selection.

Not all parts of the bench are required to be hardwood. If you are concerned with both function and form, the trestle that supports the bench top should be made from the same material used to construct the top. If you are concerned only with function, you may want to consider the use of less expensive softwood for the legs such as fir or pressure treated lumber. I have provided two sets of instructions for constructing the trestle, one for hardwood and one for softwood.

| Common Species Name | Density lb/ft$^3$ | Modulus of Elasticity ($\times 10^6$psi) | Impact Bending (in) | Side Hardness (lbf) | Volumetric Shrinkage percent |
|---|---|---|---|---|---|
| Beech, American | 39.9 | 1.72 | 41 | 1,300 | 17.2 |
| Ash, White | 37.4 | 1.74 | 43 | 1,320 | 13.3 |
| Birch, Sweet | 40.6 | 2.17 | 47 | 1,470 | 15.6 |
| Birch, Yellow | 38.6 | 2.01 | 55 | 1,260 | 16.8 |
| Elm, American | 31.2 | 1.34 | 39 | 830 | 14.6 |
| Elm, Rock | 39.3 | 1.54 | 56 | 1,320 | 14.9 |
| Elm, Slippery | 33.1 | 1.49 | 45 | 860 | 13.8 |
| Hackberry | 33.1 | 1.19 | 43 | 880 | 13.8 |
| Hickory, Mockernut | 44.9 | 2.22 | 77 | - | 17.8 |
| Hickory, Pignut | 46.8 | 2.26 | 74 | - | 17.9 |
| Hickory, Shagbark | 44.9 | 2.16 | 67 | - | 16.7 |
| Hickory, Shellbark | 43.1 | 1.89 | 88 | - | 19.2 |
| Locust, Black | 43.1 | 2.05 | 57 | 1,700 | 10.2 |
| Maple, Sugar (hard) | 39.3 | 1.83 | 39 | 1,450 | 14.7 |
| Maple, Black | 35.6 | 1.62 | 40 | 1,180 | 14.0 |
| Oak, Black | 38.1 | 1.64 | 41 | 1,210 | 15.1 |
| Oak, Cherrybark | 42.4 | 2.28 | 49 | 1,480 | - |
| Oak, Northern red | 39.3 | 1.82 | 43 | 1,290 | 13.7 |
| Oak, Pin | 39.3 | 1.73 | 45 | 1,510 | 14.5 |
| Oak, Scarlet | 41.8 | 1.91 | 53 | 1,400 | 14.7 |
| Oak, Water | 39.3 | 2.02 | 44 | 1,190 | 16.1 |
| Oak, Willow | 43.1 | 1.90 | 42 | 1,460 | 18.9 |
| Oak, Chestnut | 41.2 | 1.59 | 40 | 1,130 | - |
| Oak, Live | 54.9 | 1.98 | - | - | 14.7 |
| Oak, Overcup | 39.3 | 1.42 | 38 | 1,190 | 16.0 |
| Oak, Post | 41.8 | 1.51 | 46 | 1,360 | 16.2 |
| Oak, Swamp Chestnut | 41.8 | 1.77 | 41 | 1,240 | 16.4 |
| Oak, Swamp white | 42.43 | 2.05 | 49 | 1,620 | - |
| Oak, White | 42.43 | 1.78 | 37 | 1,360 | 16.3 |
| Osage Orange[1] | 47.72 | 1.33 | - | 2,040 | 9.2 |
| Walnut, Black | 34.32 | 1.68 | 34 | 1,010 | 12.8 |

Table 1: Properties of selected North American hardwoods at 12% moisture content; data from [6] except as noted.

# 3 Vise Hardware

The plans are drawn based on vise hardware that can be obtained from Woodcraft Supply Corp. At the time of this writing, Woodcraft sells two types of vise hardware. One type is made in Germany

[1] green properties according to [7]

and another in China. The Chinese hardware, is about half the cost of the German. The drawings in this document are based on the German version of the vise hardware so you may have to make some adjustments if you decide to use Chinese hardware, depending upon how faithfully the Chinese copied the German design. It is important that you procure your vise hardware *before* you start building your bench because manufacturers can change their design without notice and some variations from the plan may be required regardless of your choice of hardware.

The Woodcraft stock number for the German made tail vise hardware is #17D02 and the stock number for the front vise is #17D04. The stock number for the Chinese made tail vise hardware is #144807 and the stock number for the front vise is #144805 . Handles for each vise are under stock number #17E52. You can also take advantage of the installation literature [3, 4, 5] that Woodcraft provides to customers building their own benches.

Other sources for vise hardware exist. The hardware that was used to build the bench in Figure 1 was made in Germany and according to [1], the only German manufacturer of vise hardware of this type is Gebruder Busch (makers of the Hirsch Trademark). Similar vise hardware is available from the Cambridge Tool Company of Ontario Canada and Record Marples Ltd. of Sheffield, England. Again, it is stressed that vise hardware design may change from time-to-time and it is universally recommended [1, 3] that you obtain your vise and benchdog hardware before you begin constructing your bench. You may have to depart from the plans in order to accommodate variations in vise hardware.

# 4 How to use this Document

All of the drawings are in color in order to improve clarity. The color and line-type key is as follows:

- Dimensions lines and text are drawn in black.
- Blue is used to denote visible lines
- Red dashed lines represent hidden lines
- Brown lines are used to represent wood grain
- Green center lines are used to denote an axis for a shaft or hole as well as assembly lines. It is also used to denote cutting lines and planes for sectional views.

All measurements in this document are expressed in English units. Several different scales are used throughout the document: 1″=16″, 1″=8″,1″= 4″, 1″= 2″, and 1″= 1″. The drawings are designed to be printed on letter size paper and will print exactly to scale, provided that you do not select a print option that destroys the scale. The drawings are in a vector format and you can zoom arbitrarily close without noticing a degradation in line quality.

The document is organized into sections, most of which, start with a table that provides a bill of materials required to accomplish the steps that follow. The instructions for building the components of the bench are in the form of a checklist so you can easily plan your work and keep track of your progress. Also, you will notice that some checklist items are preceded by a “dangerous curve” sign that indicates that the step requires confirming some measurements from your specific vise hardware prior to execution. These steps will appear as follows:

☐ 1. Example of a “dangerous curve” step.

Figure 34: Ensuring that the steel plate is parallel with the bench top

# 8 Construction and Installation of the Front Vise

| Quantity | Function | Material | Dimensions |
|---|---|---|---|
| 1 | Front Vise Jaw | Hardwood | $3\frac{1}{2}'' \times 6\frac{3}{16}^{+}'' \times 20\frac{3}{4}''$ |
| 1 | Front Vise Filler Block | Hardwood | $1\frac{1}{2}'' \times 2\frac{1}{8}'' \times 18\frac{1}{4}''$ |
| 1 | Rear Vise Plate Filler Block | Hardwood | $1\frac{1}{2}'' \times 2\frac{1}{2}'' \times 12''$ |
| 1 | Front Vise Hardware (Woodcraft #17D04 or equiv.) | Steel | $19\frac{1}{4}'' \times 10\frac{1}{4}''$ |

Table 6: Bill of materials for front vise

A top, front and sectional view of the front vise is shown in Figure 35. Figure 37 shows a detailed sectional view of the vise hardware in-place on the bench. The installation procedure outlined here is convenient because it eliminates the need to cut into the bench top as suggested in [2]. Also, the holes for the benchscrew, guide rod bushings and guide rods are cut in the front filler block which keeps your bench top safe from drilling and cutting errors. The disadvantage of this installation procedure is that it results in a slightly larger (less than $\frac{3}{4}''$) moment arm than the design in [2] which creates more stress on the vise hardware; however, the vise hardware is quite stout as can be seen in the photograph shown in Figure 36.

☐ 1. Figure 38 shows the locations of the holes that must be drilled in the front vise filler block if you are using the German vise hardware. Take measurements from your vise hardware to confirm

the location of these holes prior to proceeding. If you are using different vise hardware, try to use your front mounting plate as a template if it can be disassembled. The next few steps are specific to the German vise hardware.

☐ 2. Using a $2\frac{1}{4}''$ diameter Forstner bit in a drill press, drill holes $\frac{9}{16}''$ deep for the guide rod bushings as shown in Figure 38 . Note that the Forstner bit can cut a partial hole as long as the center spur is in contact with the wood. You can use a cheaper $2\frac{1}{4}''$ paddle bit to drill these holes; however, you will have to clamp a piece of scrap wood to the top edge of the filler block prior to drilling.

☐ 3. Use a $1''$ diameter Forstner bit in a drill press to drill completely through the filler block to accommodate the guide rods.

☐ 4. Using a $1\frac{3}{8}''$ diameter Forstner or paddle bit, drill a hole for the front vise benchscrew completely through the filler block at the location shown in Figure 38

☐ 5. Glue-up stock to form the front vise jaw. Clamp the drilled filler block to the inside face of the jaw so that the bottom edges are flush. Spot drill $1''$ and $1\frac{3}{8}''$ diameter holes in the jaw using the filler block holes as pilots. Disassemble and drill completely through the jaw with the appropriate bits. Be sure to place the front face of the jaw firmly on a piece of scrap to avoid splitting out the hole as the drill bit exits.

☐ 6. Insert the guide rod bushings into the filler block and align the flat top of the bushing with the top face of the block. Drill $\frac{5}{32}''$ pilot holes into the wood using the counter-sunk holes in the bushings as guides. Use #16 wood screws to fasten the bushings in-place.

☐ 7. Remove the benchscrew and guide rods from the vise base plate. Insert the benchscrew and guide rods through the holes in the face of the jaw. Slip the filler block over the benchscrew and guide rods to ensure that the assembly will operate smoothly after being mounted on the bench. When satisfied, remove the filler block.

☐ 8. Clamp the filler block securely into place on the bottom edge of the front of the bench at the location shown in Figures 35 and 37. Insert the guide rods and benchscrew into the holes in the filler block. Place the vise baseplate onto the guide rods and thread the benchscrew into the front vise nut. Make sure that the baseplate fits flush with the bottom of the thick section of the bench and that the guide rods slide without binding. If you find that the plate does not fit flush, adjust the thickness of the filler block appropriately. Adjust the final size of the baseplate filler block which is nominally $1\frac{1}{2}'' \times 2\frac{1}{2}'' \times 12''$. When satisfied with the fit, disassemble.

☐ 9. Glue and clamp the filler block onto the bottom edge of the front of the bench at the location shown in Figures 35 and 37. Glue and screw the baseplate filler block into place. Allow the glue to cure.

☐ 10. As an option, you may decide to cut decorative edges on the outside corners of the jaw as shown in Figure 35. If you decide to do so, use the 1:1 template of Figure 6 as a guide Cut the decorative edges using a band saw and sand smooth.

☐ 11. Place the jaw on the guide rods and benchscrew . Insert the guide rods and benchscrew into the holes in the filler block. Place the vise baseplate onto the guide rods and thread the benchscrew into the front vise nut. Screw the baseplate up to the filler block. Use the holes in the bottom

 

of the baseplate to guide a $^5/_{32}''$ drill bit to drill pilot holes for #16 woodscrews or $^1/_4''$ lag bolts that secure the baseplate to the bench. Install the screws or bolts and test to make sure that the assembly does not bind. If binding occurs, use shims to correct the problem.

☐ 12. Tighten the jaw to the front of the bench. Using the holes in the front vise face casting as pilots, drill $^5/_{32}''$ holes for #16 wood screws and fasten the casting to the jaw.

☐ 13. Plane or sand the top of the jaw flush with the bench top.

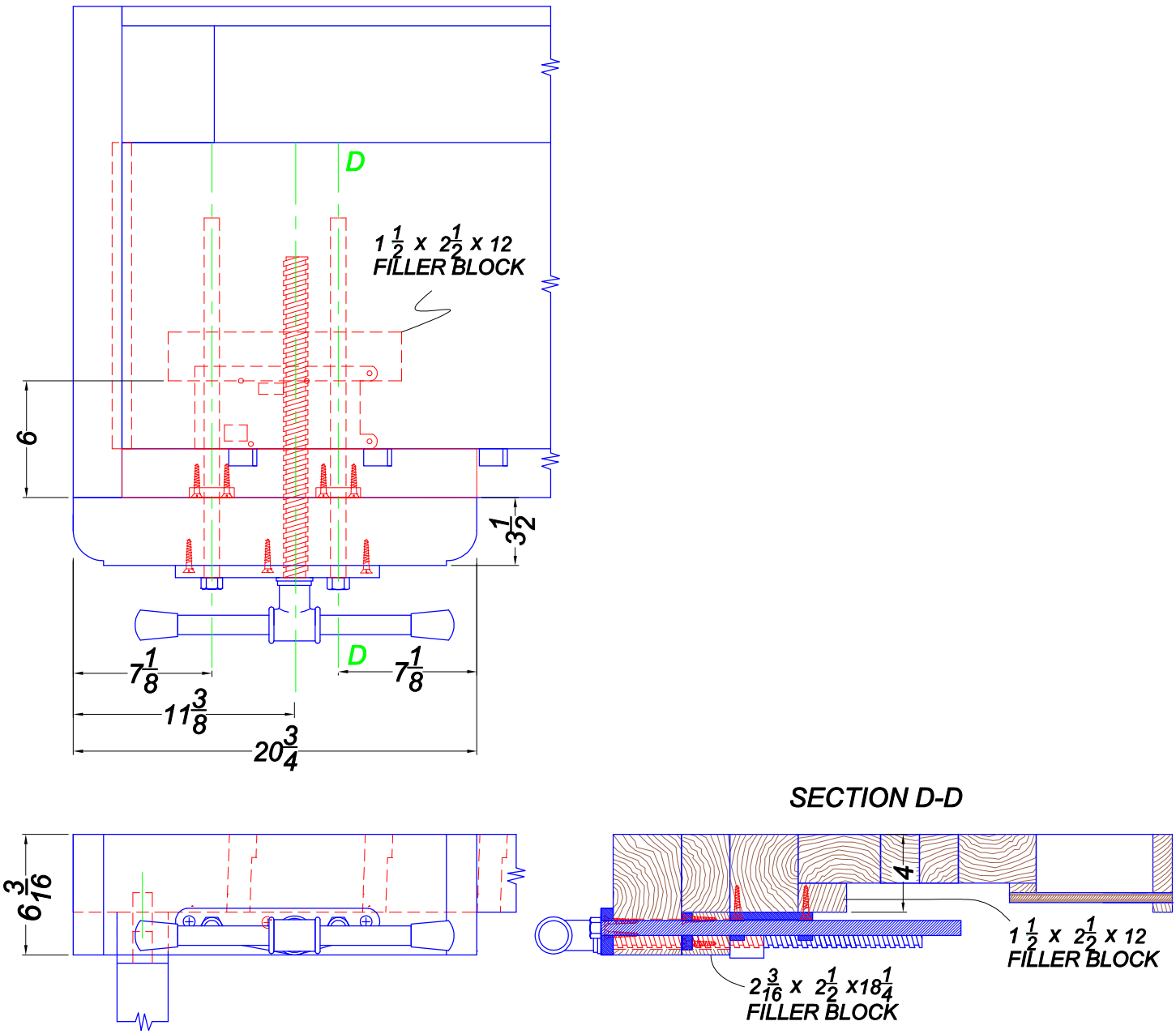


Figure 35: Front vise top, front and sectional view, $1''= 8''$


Figure 36: Front vise installed

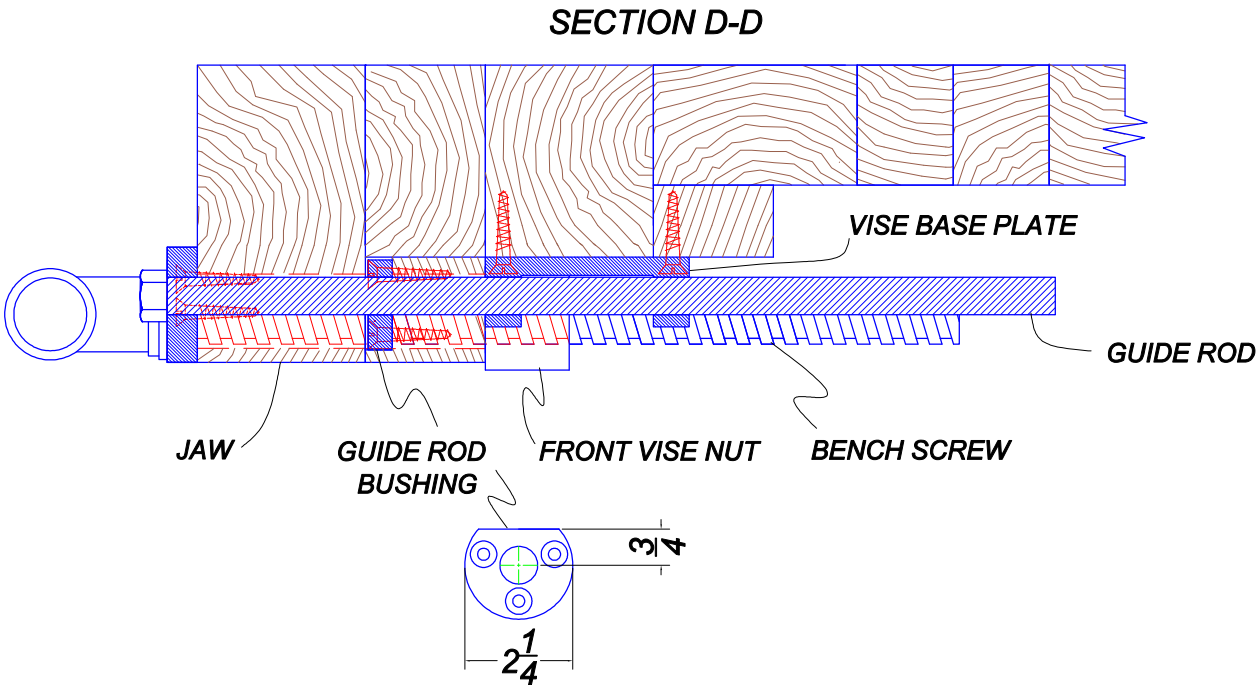


Figure 37: Front vise Section D-D detail, 1″= 4″

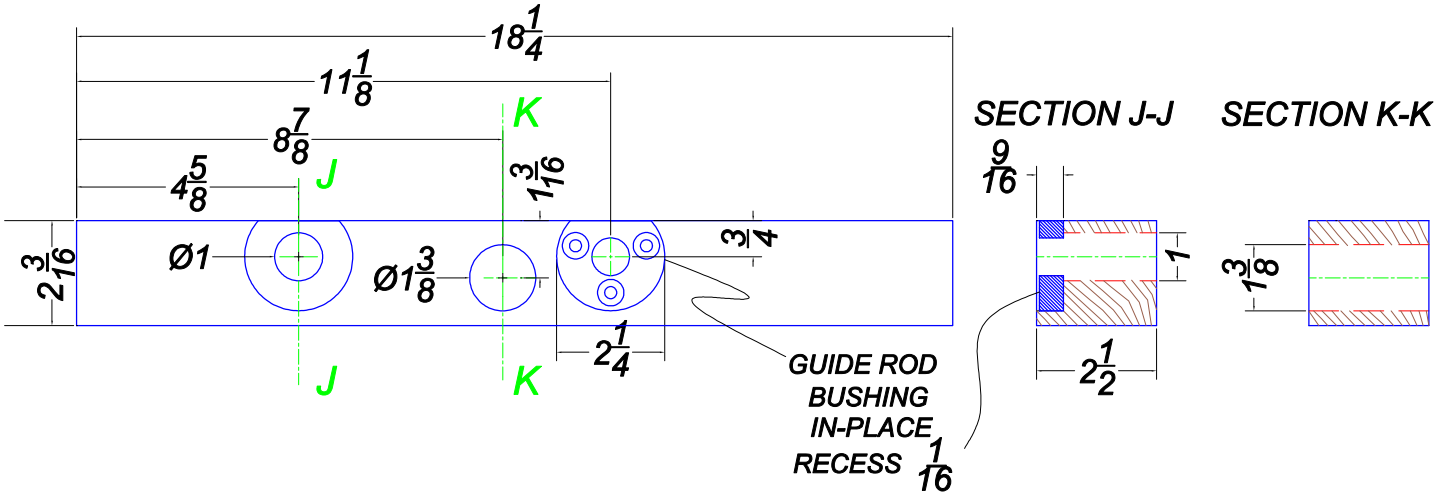


Figure 38: Front vise filler block, 1″= 4″

# 9 Construction and Installation of the Drawer

The tool drawer is a convenient place to keep frequently used tools like a marking gage, chisels, mallet, and measuring tools. Figure 39 shows a suggested method of constructing the drawer. The drawing shows the use of half-blind dovetails throughout; however, box joints could be substituted at the back because it will not subjected to pulling stresses. Figure 41 shows a photograph of a finished drawer in use.

| Quantity | Function | Material | Dimensions |
|---|---|---|---|
| 1 | Front | Hardwood | $^{13}/_{16}'' \times 5\,^{3}/_{8}'' \times 18\,^{3}/_{8}''$ |
| 1 | Back | Hardwood | $^{13}/_{16}'' \times 5\,^{3}/_{8}'' \times 18\,^{3}/_{8}''$ |
| 2 | Sides | Hardwood | $^{13}/_{16}'' \times 4\,^{3}/_{8}'' \times 18\,^{1}/_{4}''$ |
| 1 | Bottom | Plywood | $^{1}/_{2}'' \times 18\,^{3}/_{8}'' \times 18\,^{1}/_{16}''$ |
| 2 | Drawer Guide | Hardwood | $2'' \times 1\,^{1}/_{2}'' \times 22\,^{1}/_{2}''$ |
| 2 | Slides | Hardwood | $^{1}/_{2}'' \times {}^{9}/_{16}'' \times 16\,^{7}/_{8}''$ |
| 1 | Stop | Hardwood | $^{13}/_{16}'' \times {}^{13}/_{16}'' \times 10''$ |

Table 7: Bill of materials for drawer

☐ 1. Use a router to cut a groove $^{1}/_{2}''$ wide, $^{1}/_{8}''$ deep, and $^{9}/_{16}''$ from the top outside edge of each side as shown in Figure 39. Make the cut on a router table along the entire length of the sides.

☐ 2. Rout a groove $^{1}/_{2}''$ wide , $^{3}/_{8}''$ deep, and $^{1}/_{2}''$ from the bottom inside edge of the drawer front as shown in Figure 39. Make the cut on a router table along the entire length of the front.

☐ 3. Cut the pins for the dovetails in the drawer sides as shown in Figure 39.

 

# 11 Finishing

The Workbench Book[1] provides several options for finishing a workbench. Some of the recipes consist of blending oils, waxes, paraffines and turpentine . Such exotic home blends may have some advantages; however, I would recommend keeping things simple by using a commercially available oil-based finish. Several coats of boiled linseed oil were applied with a cloth to all exposed surfaces wooden surfaces on the bench shown in Figure 1. An oil finish is easy to repair when damage occurs and can be applied year-after-year to keep the bench looking new. Although it is more expensive, the widely available Minwax Tung Oil finish is also nice to work with and produces a glossier finish. In this application, an oil finish is preferable to harder finishes like shellac or polyurethanes.

# 12 Conclusion

I hope that you enjoy using your new workbench. I am sure that there were many times that you wished that you had such a bench during the course of building the bench itself. As you are now well aware, the workbench design and construction is far more complex than one might expect from a casual glance at the finished product. Credit for the bench design must go to our ancestors. I hope that my presentation of the design has made your building experience enjoyable.

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