

# Building the Collapsible Work Bench: Plans and Detailed Instructions



**Bench designed by Chuck Behm**

## The Collapsible Work Bench



### Rationale-

A solidly built, functional work bench gives the piano technician the platform on which to do many of the jobs necessary in restoring pianos. With a dedicated work area such as this bench provides, bringing actions, keyboards and even entire pianos to the shop to work on is more feasible than if temporary work areas (card tables, the kitchen table, countertops, etc.) are used.

For the technician who is currently without actual shop space, the building of this work bench would be a good first step in the construction of a professional quality work area. One advantage of this bench is that it was designed to be useful for a variety of purposes. Convenient storage for small tools and action parts, plus a large flat work area makes it ideal for action repair and grand action regulation. With the attachment of the suggested woodworking vise, keytop replacement and repair may be easily done. For the refinisher who brushes on a finish, all aspects of refinishing may be completed on this bench.

The bench was designed to be extremely solid and is very professional looking. When properly equipped with tools and supplies, it affords the technician a focal point for a small shop which would be an inspiration to do top quality work.

## Overall Game Plan

The suggestions on these two pages are for the benefit of the technician unaccustomed to undertaking substantial woodworking projects such as will be entailed in the building of this bench. For those who are used to shop work of this nature, feel free to skip ahead to the blueprints to get on with actual bench building. For everyone who has purchased these plans, woodworker and non-woodworker alike, thank you and good luck in building an extremely useful piece of shop equipment.

**1. Look over the plans:** Before purchasing any lumber or hardware, check over the overall dimensions of the bench as described in these plans, and compare those measurements with the space which the bench will occupy. Now is the time to decide on any alterations in dimensions that would affect the amount of material to be purchased. If, for example, you wish to build a bench longer than the 6 foot described in the directions, that will affect the length of certain boards you will need to purchase.

**2. Shop for materials:** With your bill of materials (detailed on page 5 following Game Plan) in hand, do your shopping for lumber and hardware. Home improvement stores such as Menards, Home Depot, or Lowes, etc. should carry everything that you will need. (As far as the screws listed, an attempt was made after the fact to count all the screws used in the finish product. The price quoted is merely a guesstimate, however, since I used screws from bins already stocked in my shop. Whenever possible, I would recommend buying screws by the box to have plenty to spare.) Everything required to build your bench will fit in the back of a minivan (with the rear seats removed), or on the bed of a full-size pickup. If a vehicle of adequate size is not available, most home improvement stores will deliver your materials for a fee, or offer a truck to rent.

**3. Space requirements:** It would work best if one half of a stall of garage space (or the equivalent in your basement or shop) could be cleared out for the building of your bench. Some of the assembly will be done on the floor, while other work would be best done on a bench type surface. Obviously, if you're building a bench, it may be because you don't have one, so feel free to improvise for a temporary work surface. An old door on top of two card tables, for example, would give you an adequate space to do the assembly work requiring a bench surface. Working in either a heated or air-conditioned area, or a garage open to the weather in the spring or the fall (if you live in a climate with extremes in temperature) would be preferable.



**4. Tool requirements:** Although this bench could be built with hand tools alone, certain power tools will make the job much easier. In building the prototype the following power and hand tools were used:

- Power miter saw
- Table saw (used both with dado-head set up and ordinary crosscut blade)
- 14" band saw
- Drill press
- Mortising machine
- Electric hand drill
- Router
- Various bar clamps and C-clamps
- Various drill bits, router bits, saw blades, etc.

The most useful single power in the list above for this project would be the power miter saw, in that it was used to cut all the longer boards to length. A circle saw could do the work of the table saw, and a saber saw could be substituted for the band saw. The drill press, mortising machine and router are used for operations which could hypothetically be omitted.

**5. Time requirements:** The prototype bench took the better part of 3 weeks to build, but that was without a clear plan, or single measurement to work with, except that the finished product needed to fold down to a dimension that would fit into the back of a minivan. With a proper materials list (so that 6 trips to the home improvement store would be unnecessary!), and actual measurements to be used for cutting the lumber, this should be a project that would be doable in a couple of weekends, for the average woodworker, at any rate. If this is the first major woodworking project attempted, you could probably count on doubling that time.

**6. Skill requirements:** The tried and true woodworker should find this project a piece of cake to build. I've tried to write the directions clearly enough that even someone unfamiliar with wood shop procedures should have a good idea of what needs to be done. If you happen to be a person with little or no experience in building projects from wood, I would encourage you to enlist the aid of a friend or relative who is more experienced to lend a hand.

*For everyone building this workbench, whether experienced or not: For any procedure in which heavier power tools, such as the table saw, are used, have another person in the shop. Do not, under any circumstances, use power equipment when overly-tired, or impaired with alcohol or medications.*

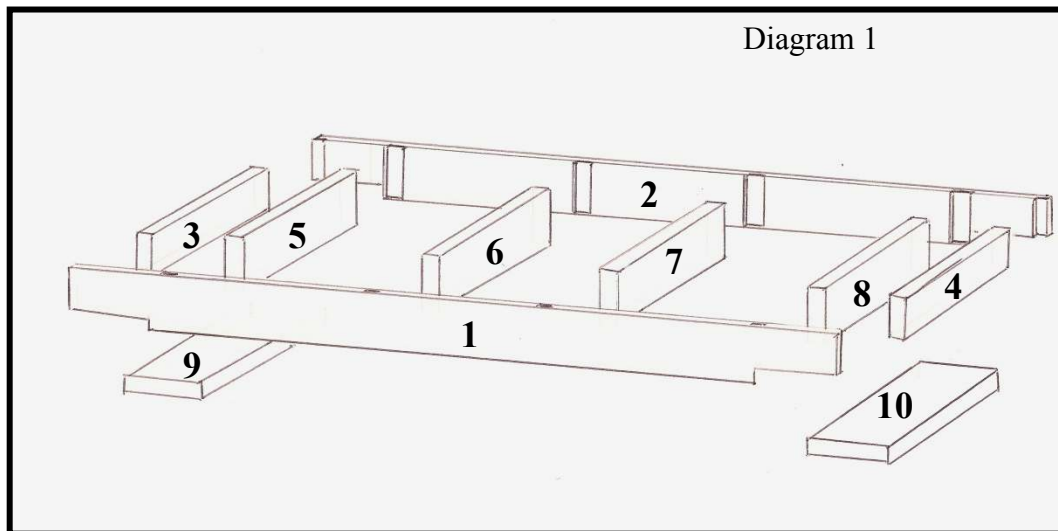
**Bill of Materials**

	Quantity	Dimension	Type	Estimated Cost*
<b><u>Lumber:</u></b>	3	2 X 6 X 8 foot	Douglas Fir	\$9.48
	7	2 X 8 X 8 foot	Douglas Fir	\$27.72
	10	1 X 8 X 8 foot	Clear pine	\$159.80
	1	15/32 inch sheet	Plywood	\$22.98
	2	3/4 inch sheet	Plywood	\$63.92
	1	3/4 inch sheet	Oak veneer plywood	\$56.88
	1	1/4 inch sheet	Pegboard	\$15.00
	4	1 X 8 X 6 foot	Oak lumber	\$80.00
<b>Description</b>				
<b><u>Hardware:</u></b>	68	2" self-tapping Phillips screws		
	20	1 1/2" self-tapping Phillips screws		
	63	1" X 8 slotted screws		
	12	3" self-tapping Phillips screws		
	54	1" X 4 slotted screws		
	24	1 1/4" X 6 slotted screws		
	6	1 1/4" X 6 oval slotted screws		
	2	1" X 8 round head screws		
<b><u>Misc:</u></b>	5	9" bolts, nuts and washers		\$50.00
	6	1 1/2" X 48" nickel plated continuous hinges		\$59.88
	1	15" X 9 3/4" 30 drawer storage cabinet		\$14.48
	1	15" X 9 3/4" 9 drawer storage cabinet		\$11.48
	8	#2 storage bins 8 pack		\$6.97
	1	14" X 10' roll flashing		\$8.98
	2	12" X 36" X 1/8" gasket cork		\$12.98
	3	Electrical boxes, 2 1/8" deep		\$6.39
	3	20 amp receptacles		\$7.47
	3	Stainless steel receptacle plates		\$4.47
<b>Grand Total of Estimate**</b>				<b>\$620.00</b>

\*Based on the expenses in building the prototype.

\*\*Keep in mind that your cost will be influenced by any alterations to the plans which you make. This is intended to just give a ballpark look at what you might expect to spend.

## Suggestions for Construction of Inner Frame



*Inner Frame - Exploded View.*

### Parts List - Actual Dimensions\* / Inner Frame (I.F.)

Part #1: Front I.F. rail - 1 1/2" X 5 1/2" X 69"

Part #2: Back I.F. rail - 1 1/2" X 5 1/2" X 69"

Part #3: Left I.F. rail - 1 1/2" X 4" X 28"

Part #4: Right I.F. rail - 1 1/2" X 4" X 28"

Part #5: Left I.F. cross support - 1 1/2" X 5 1/2" X 28"

Part #6: Left center I.F. cross support - 1 1/2" X 5 1/2" X 28"

Part #7: Right center I.F. cross support - 1 1/2" X 5 1/2" X 28"

Part #8: Right I.F. cross support - 1 1/2" X 5 1/2" X 28"

Part #9: Left I.F. leg anchor - 1 1/2" X 7 1/4" X 30"

Part #10: Right I.F. leg anchor - 1 1/2" X 7 1/4" X 30"

### Step-by-Step Procedures

**1. Select straight boards of top quality 2 x 6 dimensional lumber for building the inner frame of the bench top.** Economizing on poor quality lumber will make construction of an absolutely flat bench top (necessary for regulation work) very difficult to achieve.

**2. Cut all boards to length, notch the ends of the front and back rails, and make all necessary dado cuts before assembling and gluing together any of the parts.** (See page 8 for details [steps 2A and 2B] on notching and dado cuts.) Test the width of dado cuts with a piece of scrap 2 x 6 lumber. The fit should be snug, but not so much that a mallet is needed to pound the pieces together. The two pieces for each joint should fit together by hand.

*\*To be exacting, actual dimensions will be given in parts lists - instead of listing part #1 as a 2 X 6 (what you would ask for at the lumber yard), the actual working measurements will be given.*

**3. Drill pilot holes for screws to secure cross supports in dado slots.** Counter-sink holes for a neater appearance.

**4. The flatness of the top of the inner frame is critical to producing a level bench top.** A simple method to achieve this is to assemble and glue up the parts of the inner frame on a perfectly flat area of a concrete or other hard surface floor. Cover the area to be used with a layer of contractor paper or newspaper. Then lay out the parts in their respective positions, with the top side of each piece down towards the floor.

**5. Dry fit the parts together, driving self-tapping deck screws through the pilot holes drilled in the front and back rails and in to the cross supports.**

**6. With the parts fitted together, check the squareness of the assembly.** If out of square, adjust and use a length of scrap 1 x 2 on a corner to secure.

**7. Remove all the screws, disassemble the parts, while keeping everything in approximate position and ready for gluing.**

**8. If Titebond® is to be used, lightly coat both the ends of each of the cross supports, and the inside of the dado cuts, then fit all pieces together.** Tighten all screws, which will serve as clamps to draw the joints together. If Gorilla Glue® is to be used, dampen the ends of the cross supports, apply a thin layer of glue to the inside of the dados (using latex gloves), and fit the pieces together. Tighten all screws.

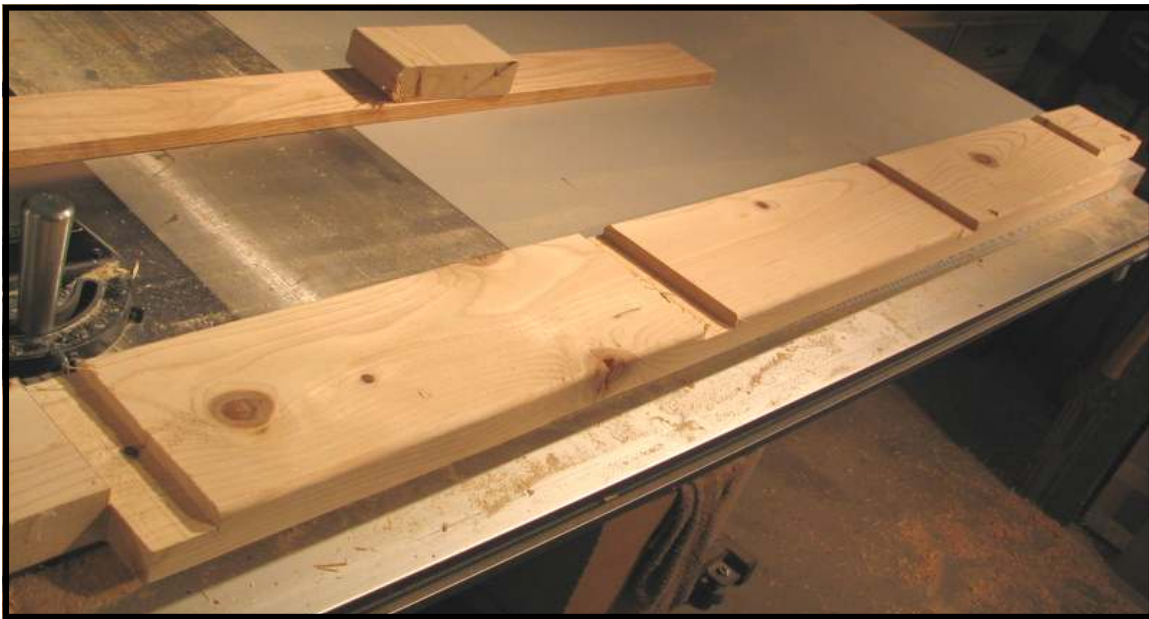
**9. If a scrap of 1 x 2 lumber was used to hold the assembly in perfect square, screw that down now.**

**10. Let completed assembly dry over night.**

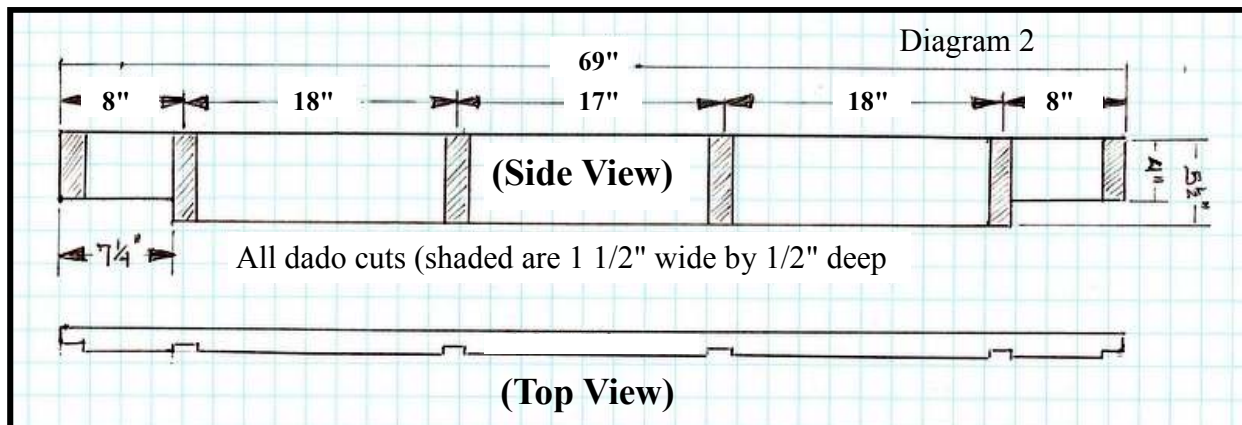
**11. Once dry, turn assembly over, so that the top side is up.** If paper has adhered to wood where glue squeezed out, sand paper any excess glue off with 100 grit sandpaper.

**12. Before proceeding to the construction of the outer frame, mount the inner frame on top of a pair of sawhorses, or other large improvised bench area.**

## Details for Notching Front and Back Inner Frame Rails



*Front inner rim rail with cuts made.*



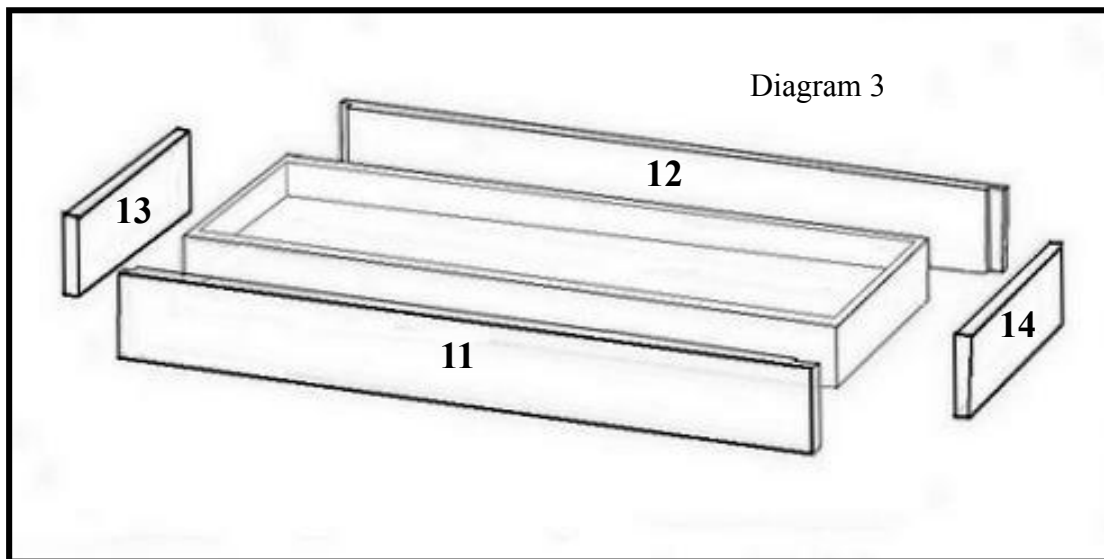
*Diagram of identical cuts to be made in front I.F. rail (part #1) and back I.F. rail (part #2).*

**2A. Use either a band saw (recommended) or saber saw to cut notch on either end of both parts.** The notch is meant for the ends of the left and right leg anchors to fit into, so check the fit with a scrap piece of 2 X 8 stock.

**2B. On a table saw, use dado head set up to cut out 1 1/2" X 1/2" dado cuts at intervals indicated in the above diagram.** An alternative tool for this job would be a router with a 1/2" or 3/4" straight bit. A easier, but less rigid method would be to use butt joints in place of dado joints. To use butt joints, trim 1" off of the right and left rails, part #3 and 4, and also off of the cross rails, parts # 5, 6, 7 and 8.



## Suggestions for Construction of Outer Frame



*Outer Frame - Exploded View.*

### Parts List - Actual Dimensions / Outer Frame (O.F.)

Part #11: Front O.F. rail - 1 1/2" X 7 1/4" X 72"

Part #13: Left side O.R. rail - 1 1/2" X 7 1/4" X 31"

Part #12: Back O.R. rail - 1 1/2" X 7 1/4" X 72"

Part #14: Right side O.R. rail - 1 1/2" X 7 1/4" X 31"

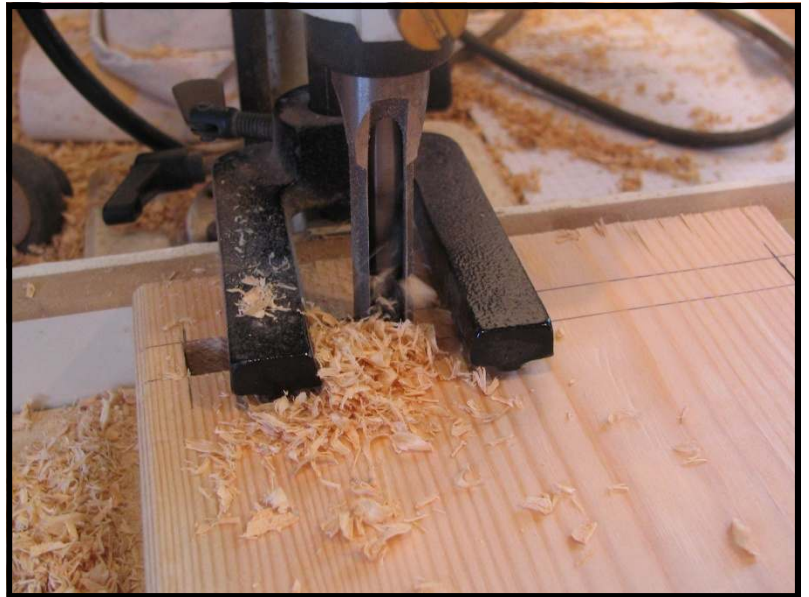
**13. Cut the 2 X 8's selected for the outer frame to length.** Before cutting, however, decide if you prefer to use dado joints (recommended) in joining the corners of the outer frame together, or if you prefer to use simple butt joints. The measurements in the table above are for dado joints, with a 1/2" deep dado cut into the ends of the front and back rails. **(Which ever joint you chose, cut the side rails just a bit long [ 1/2" or so] for the time being.)** If you would rather use butt joints, subtract an inch from the length of the left and right side rails, and cut them approximately 30" in length. A third option is to use mortise and tenon joints for the outer frame, as was done in the prototype, which results in the most rigid construction. For mortise and tenon joints, cut the left and side rails approximately 34" in length. This type of joint requires special equipment (see below) and is only recommended if you are either an experienced woodworker, or if it is a technique that you might put to further use on future projects.

**Tip:** If you do decide on mortise and tenon joints, purchasing of a dedicated mortising machine and a dado cutter for a table saw, if you don't have the equipment already in your shop, will enable you to obtain very good results with not a lot of practice. Following are steps to follow with this equipment to make your own mortise and tenon joints for this bench project.

## Collapsible Work Bench

## THE BENCH TOP

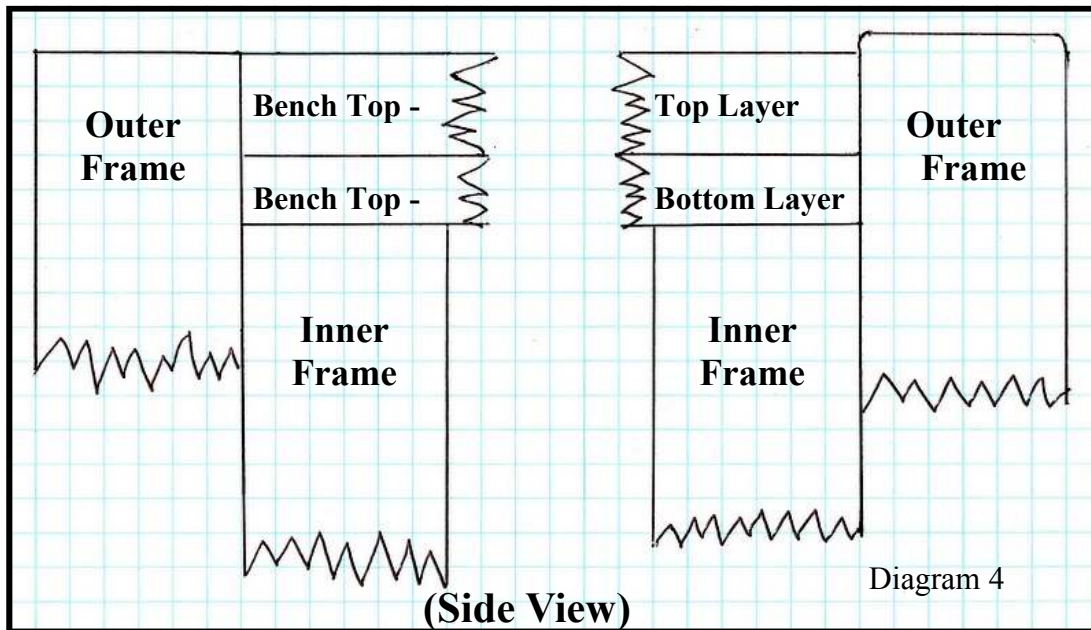
**13A. Mark and cut the mortises.** For this joint, it works best if the outer edge of the mortise is the same distance from the edge of the front and back rail as the thickness of the side rail. Use of an offset tenon (see page 21 for more information) will reduce the chance of the wood between the mortise and the edge of the rail from splitting out. Also, instead of cutting completely through from one side, cut part way through from the first side, and finish up from the reverse side. Be sure to keep the mortising bit clear from clogs.



**13B. Mark and cut the offset tenons.** A table saw equipped with stacked dado head cutter works well for this operation (photo on right). Don't try to cut the entire depth of cut in one pass. Rather, cut a shallow cut, then turn up the blades to cut additional wood. Repeat until the thickness of the tenon is a snug fit in the mortise. Finish cutting out the corners on a bandsaw (insert).

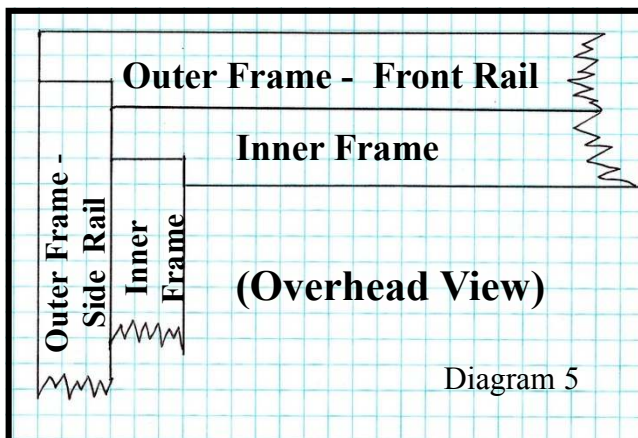


**14. Decide also if you wish to end up with the top of the outer frame flush with the main part of the bench top, or if you prefer to have it slightly elevated (to prevent drill bits, pencils, etc. from rolling off onto the floor. (See diagram on next page.)**



*Treatment choices for bench top - flush vs. raised outer frame.*

**15. If you prefer to end up with a bench top that is flush with the outer frame, such as on the left in the cut-away diagram above, you must rip a narrow strip off the top of each of the 4 frame pieces in your table saw. (Use a scrap of your 2 X 8 lumber to see what the least amount of wood needs to be removed in order to square off the top shoulders.) Otherwise, if you leave the rounded edge on the lumber as it comes from the store, and measure for a flush fit, you will end up with a crevice between the outer frame and the top layer of the bench top that will be hard to keep clean.**



**16. Measure for your dado cuts for the front and back rails of the outer frame.** The width of the front and back outer frame rails (parts #11 and 12) that is *not* affected by the dado cut should be the exact width of the front and back inner frame rails (see diagram 5). As you make the cut in either end, check to make sure that you do not cut the dados too wide.

**17. Turn the completed inner frame on edge on the sawhorses or bench being used for support with the front rail down.** With the dado cuts made, place the front rail of the outer frame (part # 11) on the sawhorses, dado cuts up and in line with the inner frame.



**18. Measure carefully the combined thickness of the two layers of plywood, or other bench top material which you plan to use.** If you plan a laminate overlay on top of the 2nd layer of plywood, add that in as well. Determine from this measurement the depth at which the inner frame will be placed in relationship to the outer frame. If you wish the outer frame to be flush with the bench top, such as in the left view of diagram 4, draw a line on the inside of the outer frame at the exact thickness of the combined bench top materials. If you wish to have a ridge or lip, such as in the right view of diagram 4, add the height of the desired ridge to the thickness of the bench top materials, and mark the inside of the outer frame accordingly.



*Inner frame and outer frame are screwed and glued together.*

**19. Place the inner frame on edge on top of the outer frame, with the upper edge touching the pencil line.** Check to make sure the cut for the dado made in the outer frame lines up perfectly with the outer extent of the inner frame. Clamp the two frames together with a clamp on either end, and mark for screw holes as shown in the photo above. Drill and countersink the pilot holes, then remove the inner frame, then apply either Titebond or Gorilla glue to one of the two surfaces. Finally, place the inner frame assembly back on the front rail of the outer frame, and screw them together. Since the screws act as clamps, you may wipe off any squeezed out glue, and proceed immediately to the next step.



**20. Flip the assembly over, and repeat the process for the back rail.**

**21. With the front and back rails of the outer frame firmly attached to the inner frame assembly, hold the side rails up to the dado slots in which they will fit, and mark with a sharp pencil the exact spot at which to cut.** I would recommend cutting a hair long the first time, in order to remeasure and slice off a bit at a time with your power miter saw to get a perfect fit.

**22. Glue and screw the side rails in place.** If you want, you may use screws or finishing nails through the front and back rail into the dado joints for extra strength. If you prefer to leave the front rail unblemished, consider pocket screws driven into the joint from inside the framework..



*Completed framework assembly with mortise and tenon joints.*

**23. Relax, and go do something else for a change. Rome wasn't built in a day.**

**Suggestions for Installation of the Bottom Layer of the Bench Top**

*Arrows indicate area covered by fixed middle section of the bottom layer of bench top.*

**24. Use a straight edge to make sure that the left and right rails of the inner frame are even with the cross supports in between.** If any of the cross supports are uneven, use shims to correct the situation before proceeding to the next steps. Failure to do so may result in an uneven work surface.

**25. The bottom layer of the bench top is in 3 sections.** The middle section is affixed (screwed and glued) to the cross supports, parts # 5, 6, 7 and 8. The bottom sections on either side are attached to the corresponding top layers of the bench top, but are not affixed to the cross supports, in that the area under the bench top on either end must be accessible.

**26. Measure the dimensions (approximately 53 1/8" X 29") indicated by the arrows in the picture above, and cut the middle section of the bottom layer of the bench top from your sheet of 15 / 32" plywood (part #15).** These dimensions will fill into the cavity between the inner frame and the outer frame from front to back, and will cover the center 2 cross supports, parts #6 and 7, and half of the outer 2 cross supports, parts # 5 and 8. Cut the plywood so that it easily drops into place from front to back - it shouldn't bind.

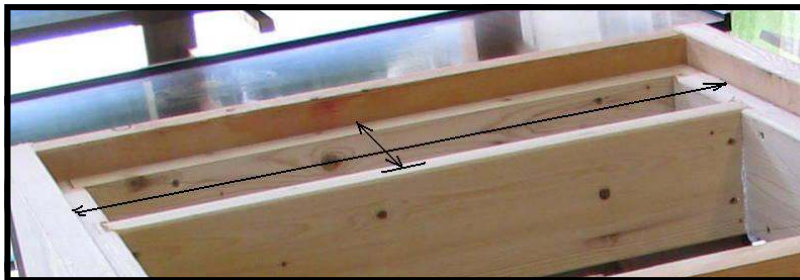


*Reference arrows*

**27. After checking fit, draw reference lines as in photo above to indicate center of cross supports (parts #6 and 7).**

**28. Place the plywood center section of the bench top on the cross supports, making sure that 1/2 of the left and right cross supports (parts #5 and 8) are uncovered. Use a 29" piece of straight one inch stock to mark a pencil line on the plywood top using the reference lines in the photo above.**

**29. Screw the top to each of the cross supports using 2" self-tapping Phillips screws, driving one screw every 6 inches.**

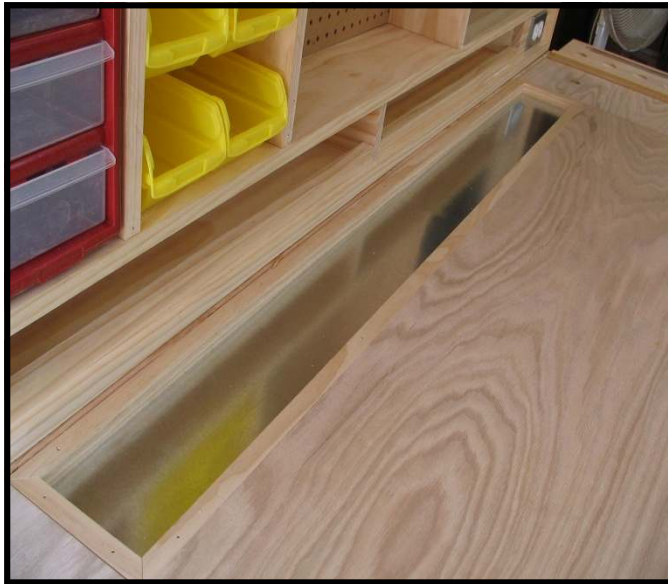


*Arrows indicate area covered by the removable side section of the bottom layer of bench top.*

**30. Measure the dimensions (approximately 8" X 29") indicated by the arrows in the picture above, and cut the side sections of the bottom layer of the bench top from your sheet of 15 / 32" plywood (parts #16 [left piece], and 17 [right piece]). Make sure that each side section drops in place without any binding.**



### Suggestions for Installation of the Upper Layer of the Bench Top



**Note:** The prototype bench was built with a shallow tool well at the back of the bench top. While this feature is convenient for placing small tools, quart cans of finish, etc., it does take up bench space. If you prefer to have maximum front to back room for such jobs as grand action regulation, you might be better off leaving the feature off. The decision as to whether or not to include the tool well affects the dimensions of the bench top material.

*Decision - Shallow tool well or deeper bench?*

#### **31. Cut the middle section of the upper layer of bench top (part #18).**

Measure to be sure, but the approximate size of the sheet you will cut will be 52 3/8" X 29" if you omit the tool well, and 52 3/8" X 23" if you include it. The side to side width of the upper layer of the bench top should be 3/4" less than that of the bottom layer. If no tool well is planned, the fit in the cavity from front to back should be snug, but not so tight that the bench top has to be pounded in place. If a tool well is to be added, the top will simply need to be butted up snug against the front rail of the outer rim.

**32. The upper layer of the bench top is screwed to the bottom layer from underneath, so that no screw heads show on the upper surface.** The easiest way to do this is to first drill the pilot holes in the bottom layer from the top down in a pattern (see photo on next page), without the upper layer in place. Once the pilot holes have been drilled in the bottom layer, position the upper layer so that it is centered, with an equal portion of the bottom layer of bench top material protruding on either side. See photo to the right.



*Offset layers*



## Collapsible Work Bench

## THE BENCH TOP

**33. Put sufficient weight on the upper layer of the bench top to hold it firmly in place (sand bags work well) and from underneath countersink the pilot holes and screw in 1" X 8 slotted screws. No glue should be used in between the lower and upper layer of bench top, so that the upper layer may be replaced if necessary at a later date.**



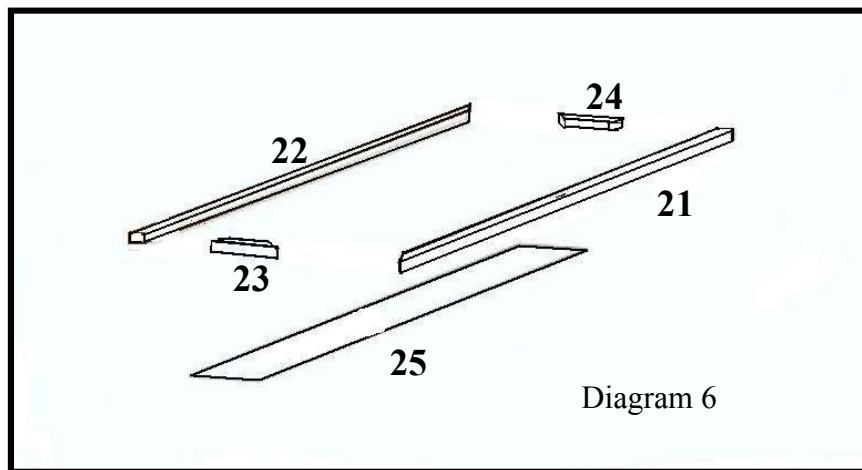
**34. Cut the upper bench top for the side pieces of bench top (parts #19 [left side] and 20 [right side]). The upper bench top should be wider than the lower layer by 1/2", which hangs over the lower layer on one side only. Again, by only using screws to secure the upper and lower bench top layers together, it will be possible to replace the upper layer in the event of excessive wear and tear at a later date.**



**35. Once the top and bottom halves of the side pieces of bench top material have been fastened securely together, use the table saw if necessary to trim off a bit of material if the fit into the cavity is too snug. The side pieces should lift easily out of place and slide easily back into place. A 3/4" finger hole drilled all the way through both layers of bench top material near the back on each side makes the lifting out of the pieces simple. This accessible cavity is necessary if the bench is being built with hinges to be collapsible, in that the legs are secured with screws through the leg anchors from above. The cavities also serve as convenient tool wells for the temporary storage of a set of tools when switching back and forth between jobs.**



### Suggestions for Installation of the Shallow Tool Well



*Shallow Tool Well - Exploded View.*

#### Parts List - Dimensions / Shallow Tool Well

Part #21: Front Trim Piece - 3/4" X 3/4" X 52 3/8"    Part #23: Left Trim Piece - 3/4" X 3/4" X 6"  
Part #22: Back Trim Piece - 3/4" X 3/4" X 52 3/8"    Part #24: Right Trim Piece - 3/4" X 3/4" X 6"  
Part #25: Flashing for well bottom - 5 5/8 X 52"

**36. If you have chosen to include the shallow tool well, and cut the bench top accordingly, first cut a piece of flashing from your roll to fit the bottom of the well. Cut it slightly smaller than the well area.**

**37. Coat the bottom of the well area (the upper surface of the exposed lower layer of the bench top) with contact cement.** Coat one side of the flashing, and put aside until the glue on both surfaces is tacky to the touch.

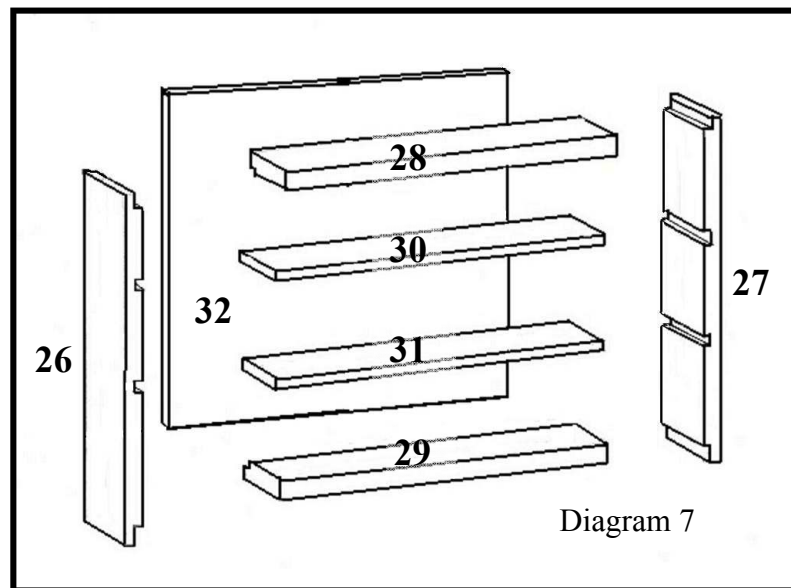
**38. Carefully line up the flashing on one end of the well, with a little room between the flashing and the front and back trim piece.** Smooth the flashing down a little at a time, working from one side of the well to the other. Use a small, flat piece of pinblock material to flatten the flashing.

**39. Put a miter corner on each of the trim pieces and fit the pieces to the well.** The front and back trim pieces are first cut to exactly match the width of the middle bench top. Use 1 inch finishing nails to tack these pieces into place, then cut the right and left trim pieces. If you start with these pieces just a bit big, then feather off a little at a time with the miter saw, it's an easy job.



### Suggestions for the Construction of the Legs

The construction of the legs for the collapsible workbench is an important factor in the extreme rigidity of the finished bench. By using a framework of Douglas fir 2 X 8's, and by doubling the legs as shelving units, the resulting larger mass of the legs adds sturdiness to the structure. By dadoing in the shelves and the backplate into the sides and top and bottom, the unit becomes nearly as rigid as if the whole unit were a solid piece of lumber 27" X 27" X 7"! With this support system on either side of the bench, it's almost as if the bench were bolted to the floor. It provides an unshakable foundation to work upon.



*Leg / shelving assembly - exploded view*

### Parts List - Actual Dimensions / Right Leg (R.L.) Shelving Unit\*

Part #26: R.L. front side support - 1 1/2" X 7 1/4" X 27"	Part #30: R.L. top shelf - 3/4" X 6 1/2" X 27"
Part #27: R.L. rear side support - 1 1/2" X 7 1/4" X 27"	Part #31: R.L. bottom shelf - 3/4" X 6 1/2" X 27"
Part #28: R.L. top brace - 1 1/2" X 7 1/4" X 27"	Part #32: R.L. back plate 3/4" X 26 3/4" X 24 1/2"
Part #29: R.L. bottom brace - 1 1/2" X 7 1/4" X 27"	

\*Parts #33 through #39 are the corresponding parts for the Left Leg (L.L.)

**40. Cut the front and rear side supports (parts #26, 27, 33 and 34), but only after deciding for certain the desired height of the bench.** The suggested 27" will yield a bench top height of approximately 34". If a higher bench top is desired, realize that if a collapsible bench is what you're after, adding to the height of the legs will make folding the legs in impossible, unless the length of the bench is added to as well. A shorter height would be no problem, in that there would be more room for the legs to tuck in.

**41. Another consideration before cutting the front and back supports is whether the bench is to be mounted on casters, or whether it will sit on the floor without casters.** Casters would add mobility, but take away somewhat from a rock solid feel. The prototype bench was built without casters, and it is difficult to move from one spot to another in the shop, even though it is on a concrete floor. But, except for collapsing it down and transporting it occasionally to conventions, the bench stays put in the shop in one spot, so casters seemed unnecessary. It is obviously a decision to give some thought to. If the decision to mount the bench on casters is made, measure the overall height of the casters and subtract that from the recommended 27" height of the supports.

**42. Cut the top and bottom braces (parts #28, 29, 35 and 36) after deciding what type of joint will be used.** A dado joint with a 1/2" deep dado would give good rigidity, without being overly difficult. The recommended 27" length of the top and bottom braces is with that type of joint in mind. A simple butt joint would be easier yet, but would not produce as strong or as rigid of a structure. (If a butt joint is desired, subtract an inch from the recommended length, and cut the braces to a length of 26".) If a mortise and tenon joint is desired, cut the braces to a length to account for the 26" span between the supports, plus the length of the tenons. In the prototype, the front tenon protruded through 1/2". The back tenon was also a through tenon, but was cut flush. The length of the braces to produce that configuration was 29 1/2".

**Tip: If you do decide on a mortise and tenon joint, the simplest thing to do is to cut and prep all four supports and all four of the braces at the same time.** That way, each time you set your saw or mortising machine for a particular cut, you can do it on all eight joints. I would suggest cutting the tenons a bit large at first, then shaving off a very small bit of wood at a time, until a snug fit is produced. If the mortise fits in by hand with firm pressure, you should have a good joint. Also, although I use a dedicated mortising machine and a dado blade on my table saw, other methods work as well. Do some research online before you begin. There is plenty of free information available. Practice with scrap wood before doing the real thing.





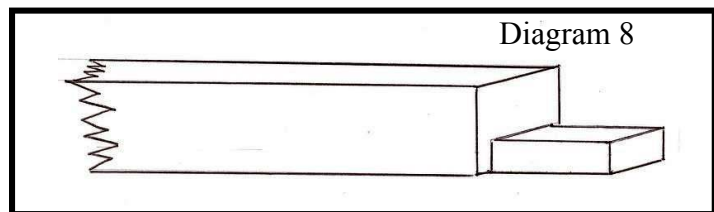
**43. Decide on the positioning of the bottom brace.** If you look at diagram 7 (page 18), you'll see that a rabbet joint has been made for the bottom brace in a way that the lower surface of the brace will be in contact with floor. This will give maximum stability. It may be advantageous, however, to raise the bottom brace a 1/2" to an inch or so, depending on the conditions where the bench will be located. In my own shop, the bench sits in front of a garage door. When it rains, and the wind comes out of the east, the floor ends up with a puddle under where the bench sits. To help the brace remain dry, I raised the mortise slot so that the bottom surface of the brace is a 1/2" from the floor.



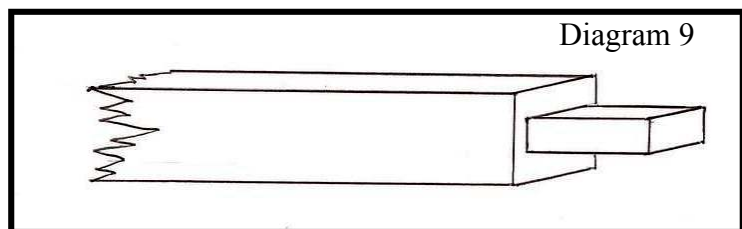
The top surface of the upper brace, on the other hand, should be flush with the upper edges of the front and rear supports, as this surface will come in contact with the leg anchors of the inner frame (parts #9 and 10).

**Tip: If using a mortise and tenon joint on a brace which is flush, either top or bottom, with the side supports, cut offset tenons flush in the brace, as in diagram 8.** This

will make it less likely that the wood of the mortise around the tenon cracks when the tenon is glued into place, in that there will be more wood between the tenon and the edge of the board that it is mortised into. The tenons used at the top of the side supports, and on the front frame work of the bench top (picture on page 12), are offset.



**If, on the other hand, the brace does not have a side that is flush with the side supports, as in the picture at the top of this page, you might prefer to make a centered tenon, as in diagram 9.** The tenon in the picture at the top of the page is centered.



**44. If a 3/4" back plate is to be used, make a rabbet cut on the inside back edge of the front and back support pieces, and the top and bottom braces.** The rabbet should be 3/4" deep, to accommodate the thickness of the plywood back plate, and 1/2" wide all the way around.

**45. Cut the desired number of shelves to length, after deciding how they will be attached to the side supports.** In the prototype, the shelves were attached with dado joints to the side supports (see photo). The advantage to this method is that it adds to the solidity of the leg / shelf unit. The disadvantage is that the shelves, once attached thus, are not adjustable. If you would like to have the flexibility of adjustable shelving, you might wish to use hardware made for the purpose of shelving, and cut the shelves to fit in the 26" cavity. If you do decide to dado the shelves in, consider what supplies will be stored on the shelves, and space them accordingly. Although the prototype bench was built with two shelves on either side, more could be added in if desired.

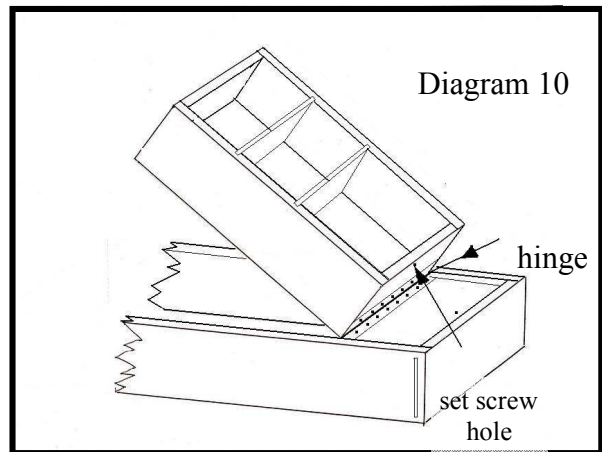


**46. Once all the parts dry fit the entire unit together.** This is especially important if you have cut mortise and tenon joints, as gluing everything together is hectic enough, without discovering after all the joints had been glued and clamped, that you've cut the rabbet for the back plate on the wrong edge of the top brace! (No particular reason I mention this, just trust me and do the dry fit first.) If screws are going to be used in addition to glue in affixing the back plate to the supports and braces, now is a good time to drill pilot holes and to countersink the holes for a neat appearance. (Make sure the unit is exactly square before drilling these holes. The back plate may be used to make minor adjustments.) Mark which side of the back plate is up, so in the hurry to assemble everything once glue has been applied, you don't reverse its orientation, thus throwing your pilot holes out of alignment.

**47. Whether you will be gluing the leg assemblies together on the floor or on a bench, cover the area with newspapers, as you will have glue squeeze out dripping underneath the unit once the clamps are set.** Have your bar clamps opened to the correct distance, so that you can assemble the supports, braces and shelves, and put the whole assembly in the bar clamps and tighten them down.

**48. Working quickly, apply glue to the joints between the front and rear supports, and the top and bottom braces.** If using mortise and tenon joints, start the tenons in the mortises, put the assembly on top of two bar clamps (with the rabbet joint for the back plate up) running parallel to the braces, and put two more clamps on the top of the assembly, and start turning down all four clamps. Turn each clamp a half turn or so then go back and forth between the clamps so that the whole thing comes together evenly. Before the joints are completely clamped down, slide the shelves into the dado joints, if those are used. Tap the shelves to the inside edge of the rabbet cut at the back of the supports. Finish tightening down the clamps. Then, remove the two clamps on top for a moment in order to put the back plate in place. Drive in one screw on either corner, then return the clamps and turn them down. Turn in the rest of the screws affixing the back plate to the supports and the braces. Once the assembly is glued together, allow it to sit overnight before removing the clamps.

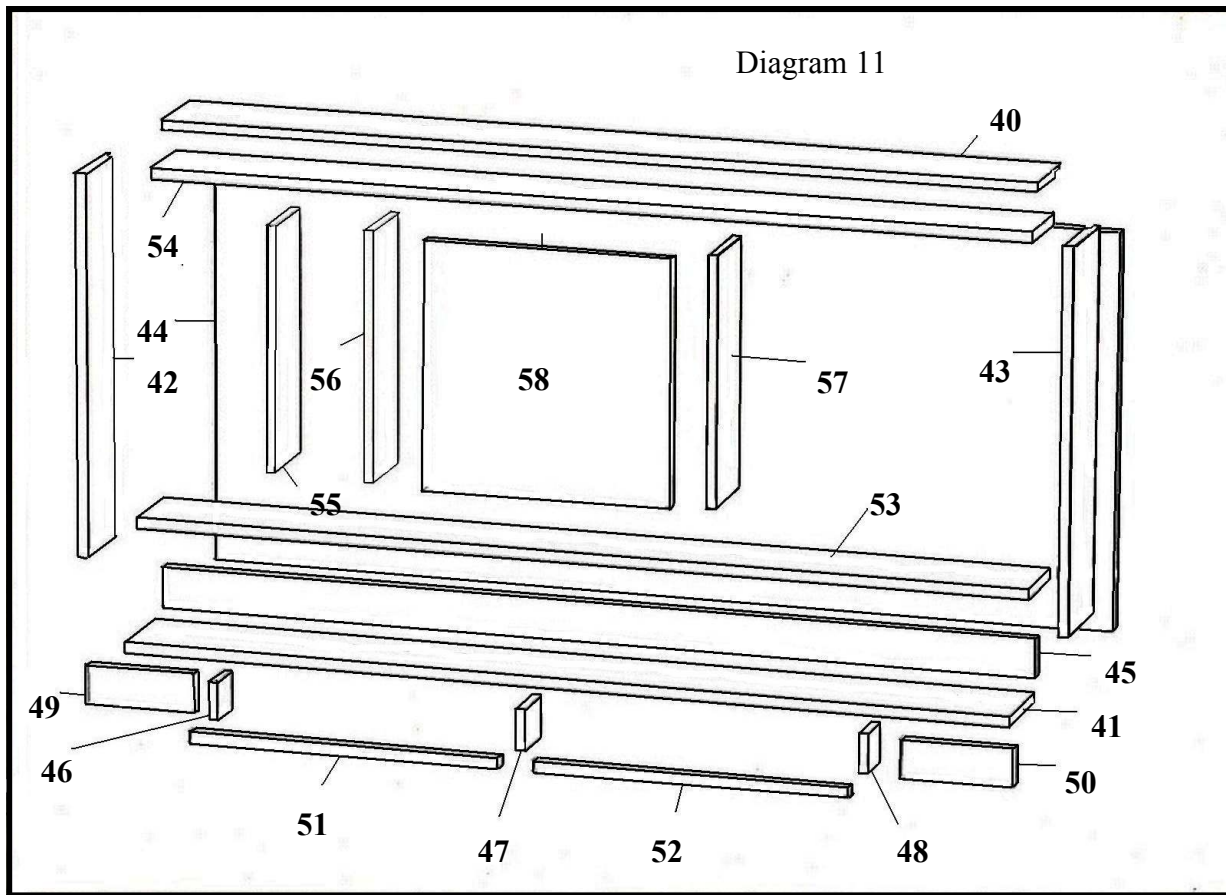
**49. Cut a continuous hinge the width of the leg assembly.** When the clamps have been removed from the leg assemblies install the hinge as shown in diagram 10. To do so place the combined inner / outer frame of the bench top assembly on top of sawhorses, the bench top down, then place the leg assembly on top of the frame, with the shelves exposed, and the bottom brace tucked in. The leg assembly should fit inside the rails of the outer frame. The hinge goes at the back of the leg anchors (parts #9 and 10), and the back of the top braces of the leg assemblies.



**50. Before turning the bench upright, as in the photo to the right, drill a pilot hole (at an angle if necessary to clear the top shelf) through the top brace of the leg assembly and into the leg anchor.** Drive a 3" self-tapping Phillips screw into the pilot hole to prevent the leg assemblies from swinging inward when turning the bench over. When right side up, drill several pilot holes through the leg anchor on either side, and drive 3 screws into the top braces.



## Suggestions for the Construction of the Back Storage



*Back storage compartment - Exploded view.*

## Parts List - Dimensions / Back Storage Compartment

Part #40: Top of frame - 3/4" X 7 1/4" X 71 1/8"	Part #49: Left outlet front piece - 3/4" X 3 1/4" X 9"
Part #41: Bottom of frame - 3/4" X 7 1/4" X 71 1/8"	Part #50: Right outlet front piece - 3/4" X 3 1/4" X 9"
Part #42: Left side of frame - 3/4" X 7 1/4" X 30 1/2"	Part #51: Left wire restraint piece - 3/4" X 1" X 25 3/4"
Part #43: Right side of frame - 3/4" X 7 1/4" X 30 1/2"	Part #52: Right wire restraint piece - 3/4" X 1" X 25 3/4"
Part #44: Back plate - 3/4" X 30" X 71 1/8"	Part #53: Bottom shelf - 3/4" X 6 1/4" X 70 1/8"
Part #45: Cubby backing board - 3/4" X 3 1/4" X 70 1/8"	Part #54: Top shelf - 3/4" X 6 1/4" X 70 1/8"
Part #46: Cubby left partition - 3/4" X 3 1/4" X 3 1/2"	Part #55: Left shelving partition - 3/4" X 6 1/4" X 19 3/8"
Part #47: Cubby middle divider - 3/4" X 3 1/4" X 4 1/4"	Part #56: Tool cabinet left side - 3/4" X 6 1/4" X 19 3/8"
Part #48: Cubby right partition - 3/4" X 3 1/4" X 3 1/2"	Part #57: Tool cabinet right side - 3/4" X 6 1/4" X 19 3/8"
Part #58: Cabinet door - 3/4" X 19 1/2" X 19 3/8"	

**51. Consider your individual supply and tool storage requirements before building the back storage compartment for your bench.** The storage built into the prototype is useful for my needs, but may not be right for you. The plans outline the building of the storage cabinet as featured in the prototype, but feel free to improvise wherever desired.





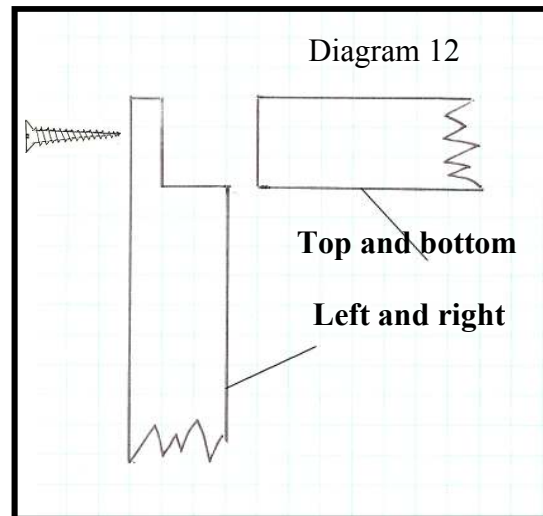
*Back storage compartment as built in prototype*

Aspects of prototype back storage compartment to consider:

- ⇒ Top shelf extending length of bench - handy for storage of small parts and supplies.
- ⇒ Section for small drawer storage cabinets
- ⇒ Section for parts bins
- ⇒ Section for pegboard storage
- ⇒ Section for TV
- ⇒ Electrical outlet on either side
- ⇒ Cubbies for storage of small electrical tools

Before building your own storage compartment, decide on customized aspects which you intend to incorporate, and redraw the plans accordingly. The first steps of the following directions concerning the shell of the storage compartment should be useful to everyone, while the latter steps having to do with individual storage areas will be useful to the person who intends to replicate the prototype.

**52. Cut the the top, bottom, left and right boards of the frame (parts #40, #41, #42 and #43).** Cut a rabbet joint in the inside edge at the top and bottom of the left and right boards, 1/2" deep and 3/4" wide. Since the back storage area does not need to support the weight of the entire bench, this joint, along with three 1" X 4 slotted screws per joint, will be strong enough to suit the purpose. Finish the preparation of the pieces by cutting an identical rabbet joint on the inside edge of all four frame boards for the back plate to fit in.

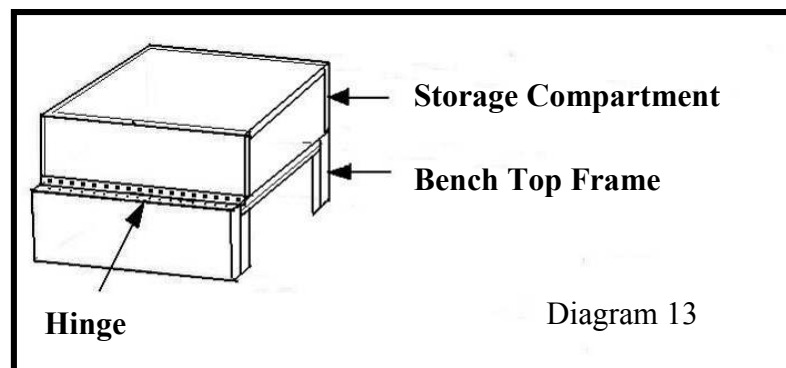


**53. Glue and screw (clamping unnecessary with screws tightened down) the frame boards together, front side down (rabbet joint up).**

**54. Measure for the back plate (part #44), and cut from 3/4" plywood.** Run a bead of Titebond glue on the inside the rabbet joint on the back of the frame. Put the back plate into place. Put a bar clamp on the middle of the frame (to prevent bowing out) and drill pilot holes and countersink for 1" X 4 screws every 6" along the top and bottom frame. Drive the screws in, then repeat the process for the sides.

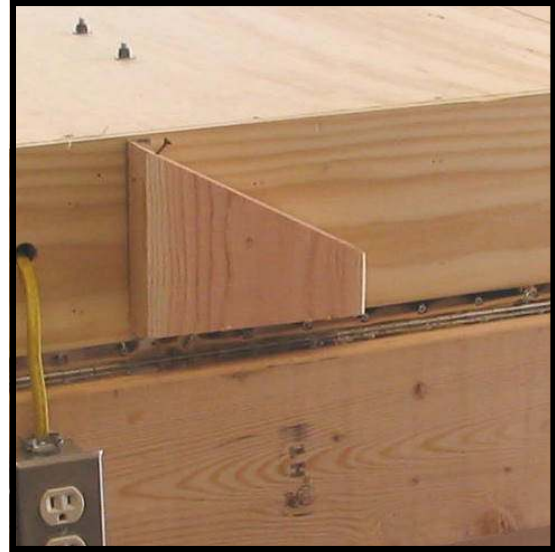
**55. Once the shell for the back storage compartment is completed, mount it on the bench with a continuous hinge.** To do so place the storage compartment face down on top of the bench, positioned so that the top of the frame is flush with the front rail of the outer frame of the bench top.

The bottom of the storage compartment frame will in this position line up with the seam between the back rails of the outer and inner frame of the bench top. Open the



hinge to a 90 degree angle, and drill a pilot hole on either end. Insert and tighten a screw on either end, the drill pilot holes for the rest of the screws. Insert and tighten all the screws.

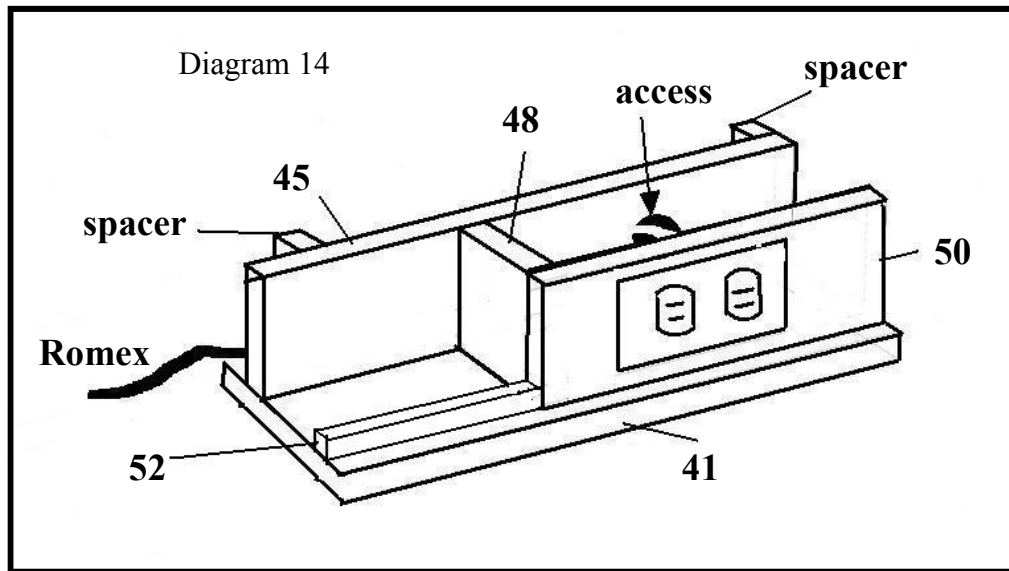
**56. To support the back storage compartment, three hinged buttresses are used, one on either end, and one in the center.** Cut these from 2 X 8 Douglas fir, to fit as shown. When the storage compartment is in the closed position, the buttresses are flipped inward on their own continuous hinges to stay out of the way. In this configuration, the buttresses protrude no further than the outer extent of the back rail of the bench top.



When the storage compartment is opened, the buttresses flip down to provide needed support for the weight of the compartment, supplies and tools. Set screws that are driven into the bottom of the frame of the storage compartment, and into the back rail of the bench top prevent the buttresses from accidentally being knocked loose. Once the folding compartment is thus secured, work may begin on the storage area itself.

**57. If the design of the prototype is to be followed, the first area to work on is at the bottom of the compartment, where the electrical service and the cubbies are located.** The electrical service at either side of the workplace are handy to plug in a Dremel tool, or other small tool. The cubbies behind the shallow tool well provide a convenient spot to stuff small electrical tools. Restraint pieces make it easy to secure the cords to electrical tools. Building this electrical service area is a quick process, with no fancy joint work required at all.





*Cut-away details of right-hand electrical service area*

**58. The first step in constructing the electrical service area is to install five spacers, as shown in the above diagram, to securely hold the cubby backing board (part #45) an inch away from the back plate so that a hidden wire may be run from one electrical outlet to the other. Rip a length of 3/4" pine into a 1" strip, then cut five 3 1/4" segments. Three of the segments need to have a 1/2" hole drilled in the center, for Romex to pass through. Glue or staple these up and down, as shown, at the back and bottom of the storage compartment area, with one on either end, and three spaced evenly in the middle of the compartment.**

**59. Drill a 3/4" access hole (shown in diagram) in either side of the cubby backing board approximately 4 1/2" in from either side. Also, drill an access hole in the back plate of the storage compartment, on one side or the other, and in line with the hole in the cubby backing board, when it is installed.**

**60. Glue and staple the cubby backing board to the spacers.**

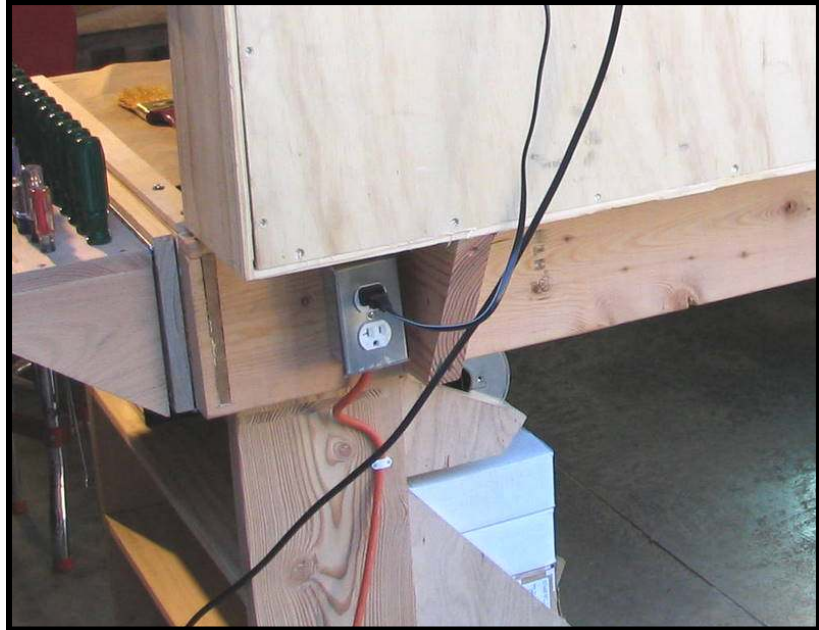
**61. Use a combination square to mark a line 9" in from either side of the compartment on the inside of the bottom of the frame. Also mark a line in the center of the compartment. Glue the left and right cubby partitions (parts #46 and #48) and toenail with brads or staples. Also glue and toenail the cubby middle divider (part #47).**

**62. Prepare the left and right outlet front pieces by cutting rectangular holes large enough to fit metal rectangular electrical boxes. (Use box as pattern.)**



**63. Glue and staple the outlet front pieces (parts #49 and #50).** Insert the metal electrical box, and with the front of the box flush with the outlet front piece, measure the exact distance between the back of the box and the cubby backing board. For each of the outlets, cut a pair of narrow shims 3 1/4" long and wide enough to fill the space. Drill pair of pilot holes at the back of the boxes and through the shims for round head screws long enough to penetrate into the backing board. Put a wire clamp on the back center hole of each box, and install.

**64. Before continuing with the woodworking, wire the outlets.** I added another box at the back of the bench (shown in picture) and ran the Romex from that outlet, to the outlet on the right, and then to the left hand side of the bench. Use a heavy enough gauge of grounded wire that you will be able to plug in whatever type of equipment you have need for.



**65. Measure and cut the left and right wire restraint pieces (parts #51 and #52), and glue and staple into place.**

**66. Cut and install the bottom shelf (part #53) with glue and staples.**

**67. If you wish to install small drawer storage cabinets, purchase them before continuing any further.** Put them into place a secure with screws. Then install the top shelf so that it is resting on top of the cabinets, and level.

**68. Install vertical partitions (parts #55, #56 and #57) as needed for type of storage desired.** Storage bins in prototype are handy for bridle straps or front rail felts. The pegboard cabinet is simple to build, and is convenient for mounting small tools. The cabinet door on the prototype is pegboard over plywood, held on with a continuous hinge. I found that the only way to mount tools was to use finishing nails to mount them in place, in that hooks were too loose to be of use when the door was swung shut. If the swinging door is installed flush with the outer edge of the shelving, it must be removed before the bench is collapsed.

**69. Apply finish to the bench top, if desired.** The bench top of the prototype was finished with 5 coats of shellac - easy to repair, yet beautiful to look at. Finish to your individual preference.



That concludes the work on the bench proper. Enjoy the process of creating a beautiful and functional piece of shop equipment.

To all who have purchased this set of plans:

**Thanks, first of all, for purchasing these plans. They were a challenge, to say the least. I hope you find them useful. Register for receiving updates and clarifications to these plans, if and when they are made available. Simply e-mail me at [behmpiano@gmail.com](mailto:behmpiano@gmail.com) to be put on my tech list. If any of the directions in these plans are unclear to you, contact me (not Schaff Piano), at the above e-mail address.**

Chuck Behm

### Adding on a Tool Rest to Your Bench



*A great platform for bench top tools.*

The addition of a tool rest to the prototype was an eleventh hour decision before the Grand Rapids convention which proved to be one of the most popular features. It is incredibly sturdy, and very simple to add on. To do so, first construct an oak plank (Douglas fir could be substituted for reasons of economy, I suppose). The tool rest pictured on the prototype is a full 3" thick, which required gluing together four 3/4" X 8" X 6' oak boards using Titebond and 36 c-clamps overnight. The finished beam is 52" in length, stretching to the very back of the bench, and then extending 20" out in front. It is 6 1/2" from top to bottom, giving it a great deal of rigidity.

Once the beam has been glue and allowed to dry, cut to length on your miter saw and rip the top and bottom on your table saw. Sand smooth and bolt to the side of the bench, using three 9" bolts. Drill holes for the bolts through the beam and through the side of the frame of the bench top. Access washers and nuts from inside the tool well.





## Collapsible Work Bench

## ACCESSORIES

Besides the oak beam, the other component of the tool rest is the tool pad which attaches to the beam and provides the actual platform for your small power or bench top tools. The tool pad pictured measures 1 1/2" thick X 10" X 12 1/2 ". It was intended as a multi-function tool pad, made to be used with a variety of small bench top piano tools, such as the looping machine, the knurler and the center pin remover.



Each of these tools in turn was mounted on a small pedestal with dowels to fit in the four holes drilled into the tool pad. The large hole in the center of the tool pad, which has been drilled with an ordinary 1/2" drill, then redrilled part way with a Forsner bit, is intended for a bolt (the same size as the ones which attach the beam to the bench top) which drops down through a hole in the beam and tightens from underneath.

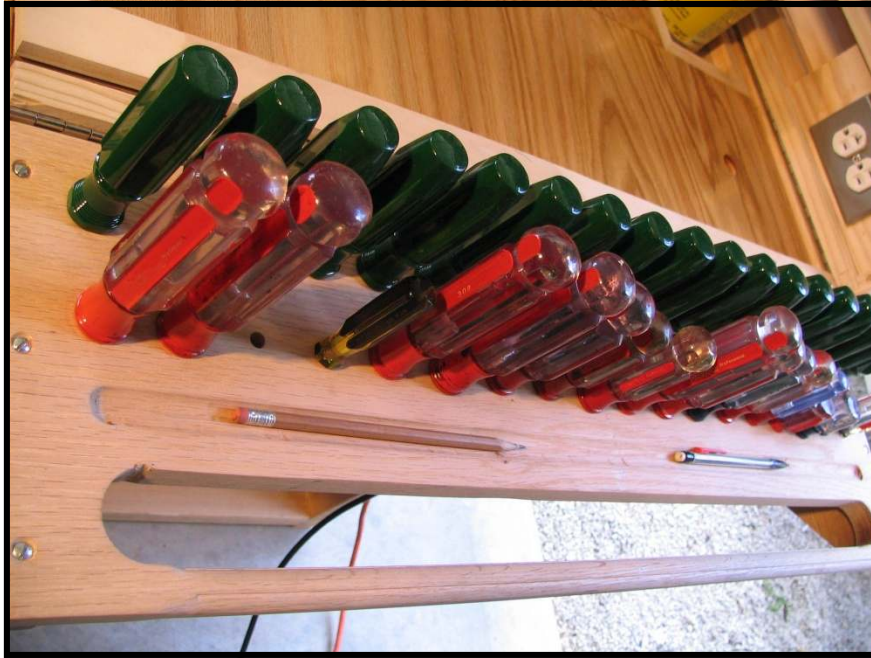


The advantage of the single bolt attachment to the beam, is that the nut on the bolt may be loosened, and the tool pad may be then rotated to whatever angle is most convenient. A separate pad was made for the grinder shown on page 31, as the bolts attaching it to the pad are left in place, and the entire assembly is lifted off and put aside when not in use.

Small bench top tools on their pedestals may be stored out of the way when not in use on a shelf built into the side of one of the leg assemblies. This shelf is positioned so that it remains attached when the bench is collapsed - it fits in between the support beams of the frame when the bench is in the folded configuration.



## Adding on a Tool Rack to Your Bench



*A handy spot for showing off tools*

**This tool rack provides a convenient spot for a collection of screwdrivers, pencils and pens, towels, and of course, regulating tools mounted on combination tool handles.** (Although the combination handle may be purchased individually, they are available in six-packs, twelve-packs and the ever popular case. The eighteen tools in the picture were 3 six-packs. I may have been better off buying a case!)

**The tool rack (shown is an earlier version which was scrapped) is mounted on a backing board with side supports and is hinged.**

The rack and side supports may be swung upwards so that long piano regulating tools are not in the way of the shelves. The backing board may also be hinged so that the whole assembly swings down out of the way (fitting into the notch) when the bench is folded. (A set screw holds the backing board up.)





### Final Ideas - Additional Accessories to be Considered

The sturdy construction of the leg / shelving assemblies permit heavy weight storage on the insides. Here, shelves for 18 boxes of tuning pins, and 1 pound reels of piano wire find a convenient spot. These shelves do need to be removed when the bench is folded up.



A bench vise, in my opinion, is a necessity for a functional bench. This particular model, a Craftsman, unfortunately, is no longer available. Good vises are available, however, through quality woodworking supply houses. Purchase a good one for it will truly be one of your most valuable tools.



Last, but definitely not least, a TV to watch your favorite movies while you work. I have a dozen or so favorite titles from which to chose from. Work, after all, should never feel like work.

Thanks again.

