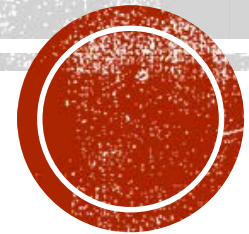


BUILDING STRETCHERS IN THE WOODSHOP

A guide to using the UC Department of Art and Art History
basic painting stretcher system and parts.

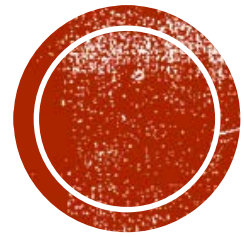


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REQUIRED READING...

- Be sure to go through this guide carefully and answer the accompanying questionnaire. Submit your questionnaire and request a shop appointment by email to steven.nunoda@ucalgary.ca.
- Remember: Although studying this guide is a required part of your shop training, it does not authorize you to come in and build on your own. Only Department of Art Technicians can do that.
- We'll set up a time for you to come in and get your workshop orientation if you don't already have it, to do your saw training and tech assistance for building.
- **Please note that you must have completed the Department of Art Safety Orientation before using any shop resources. Contact Steve if you haven't done this.**
- Be sure to follow the Workshop and Tool Room rules as well as all other DofA safety protocols.



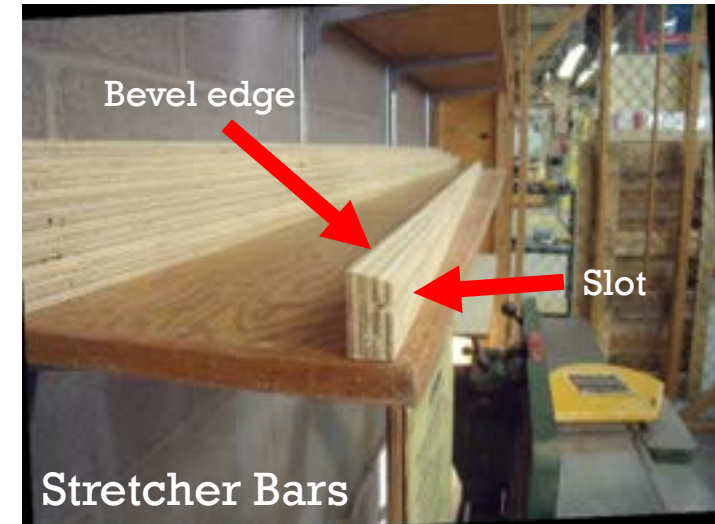


PLANNING

Essential to a good result...

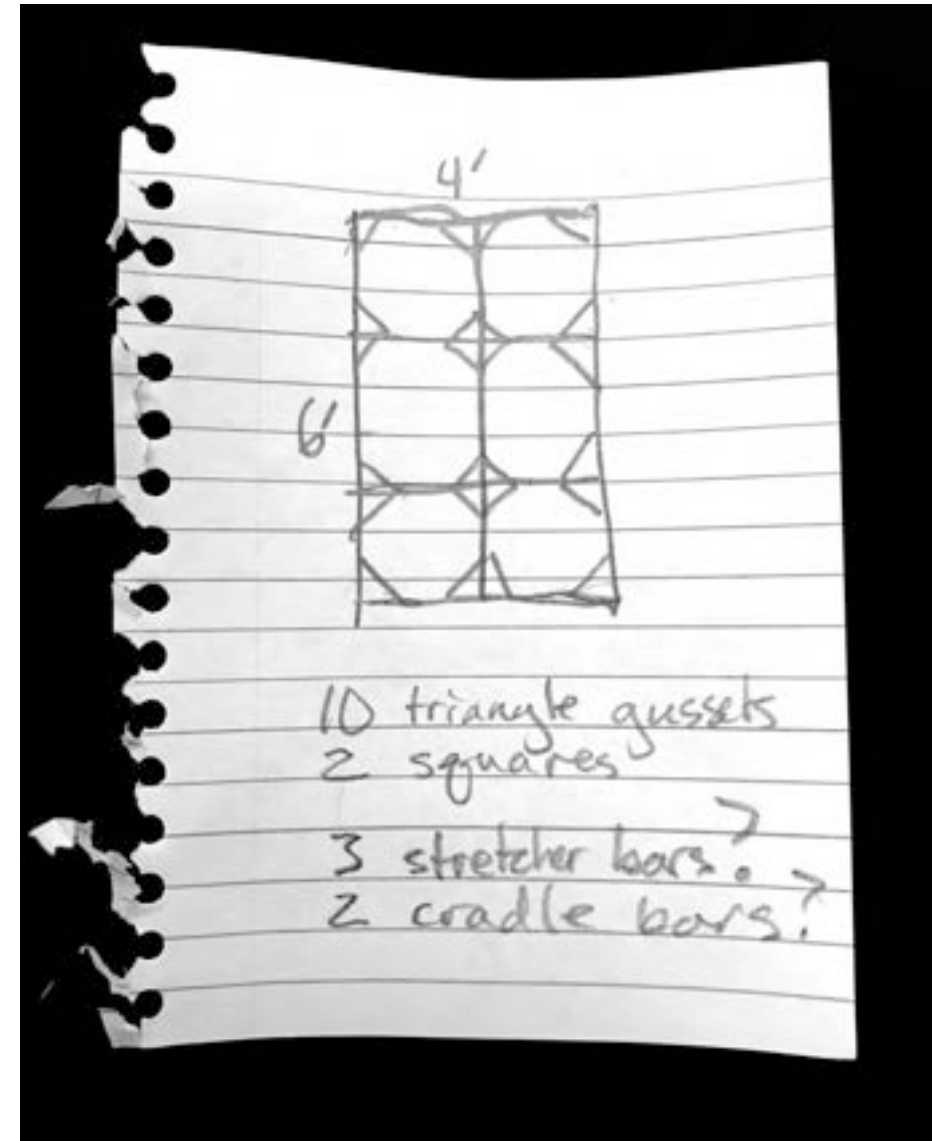
BITS AND PIECES

- The shop stretcher system is made up of stretcher bars that are pre-milled from plywood, hardboard supports called gussets that hold your frame square and, as necessary, plain plywood strips or cradle bars for cross-bracing.
- These components are cut to size with power mitre saws, then joined using wood glue and nails or “brads” fired by pneumatic (air-powered) guns.
- **Don't worry:** You will be carefully trained by the Workshop Technician (Steve) to correctly measure and safely cut and assemble the components.



FIRST STEPS

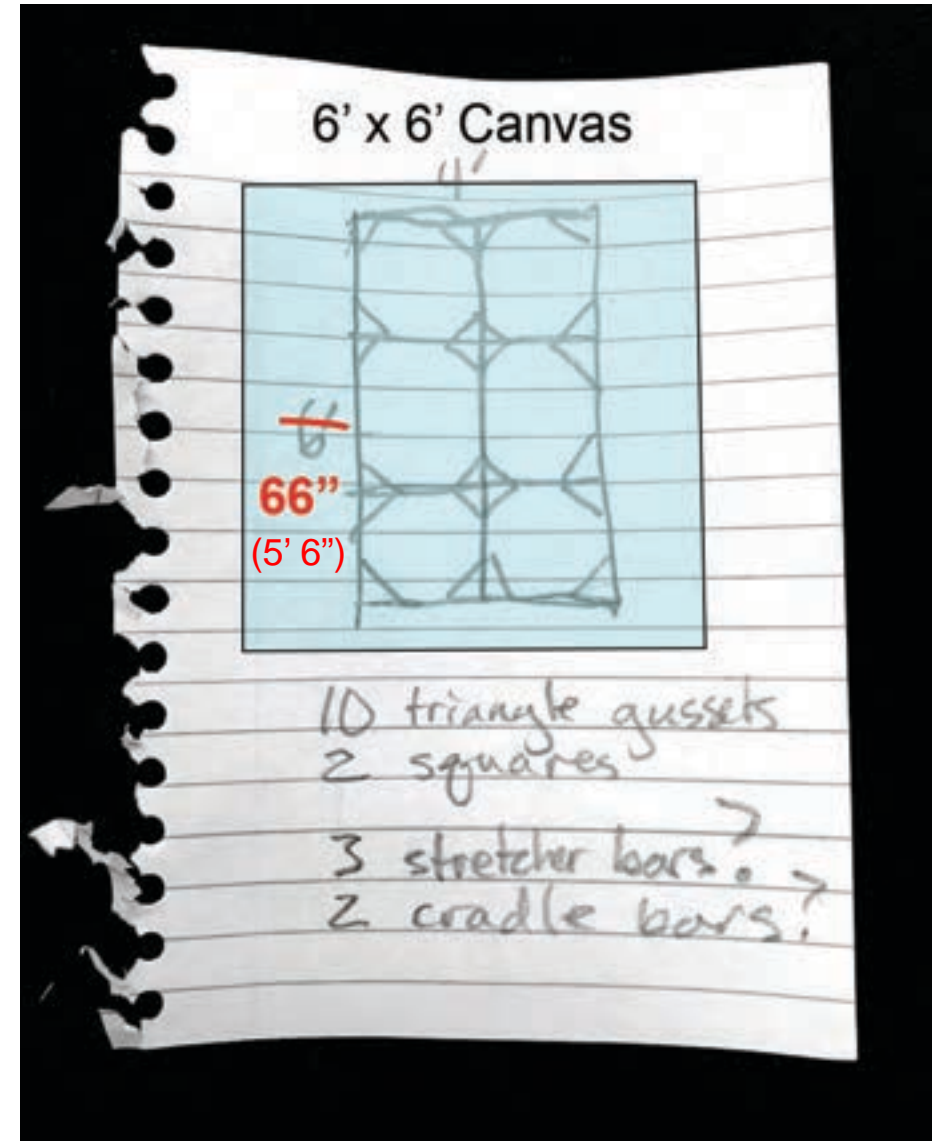
- Start by determining the dimensions of the stretcher. What's the basic shape and size? If it's weirdly shaped (not rectangular) or larger than eight feet per side, see the Workshop Tech for a one-on-one consultation in person or on-line.
- First, make a "thumbnail sketch" of what you want with sizes indicated. You can work in metric but the canvas and bars are all in Imperial measurements.
- Now you can start to figure out how much material you'll need. Remember, stretcher and cradle bars are eight feet long and the hardboard strips for gussets give you about 10 triangles per strip.



PLANNING BY CANVAS

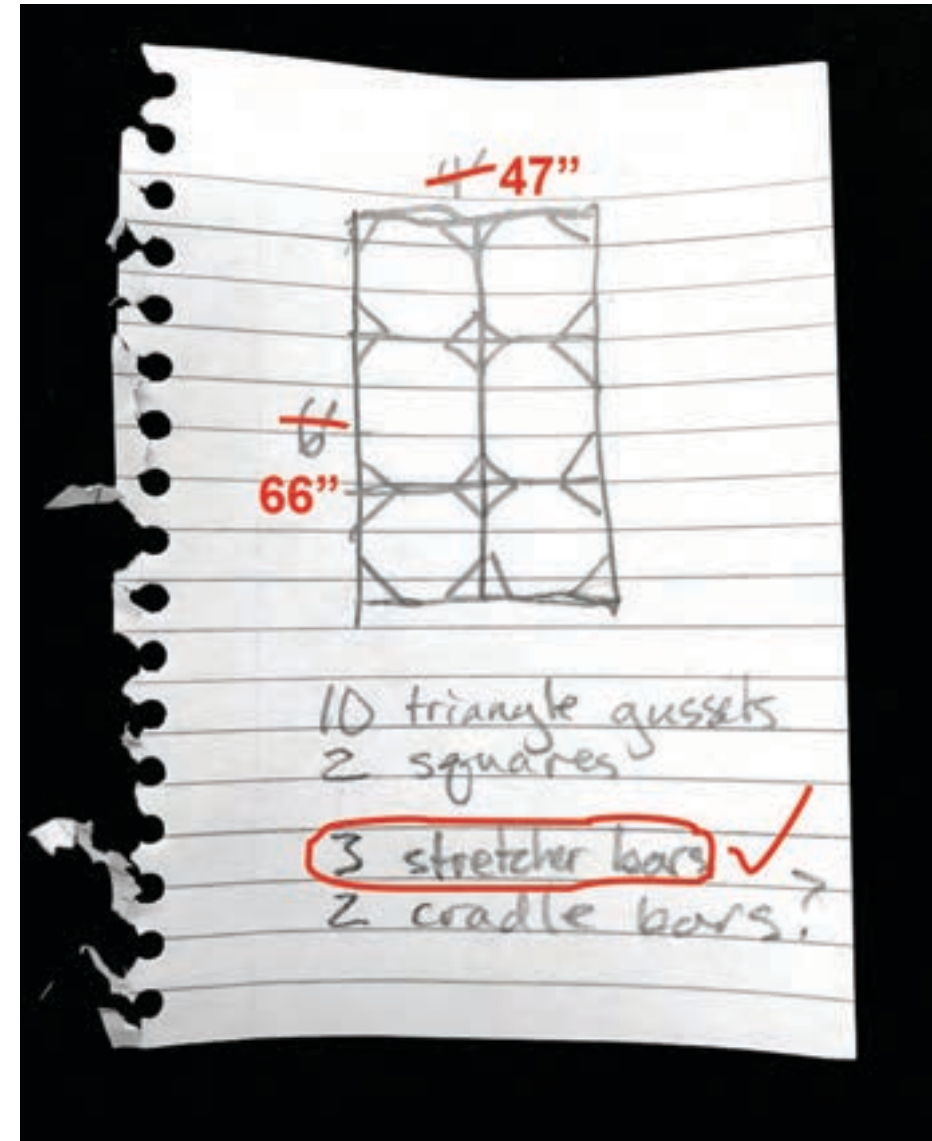
- Be sure to account for the dimensions of canvas available: The UC Bookstore sells 4 foot (48 inch) and 6 foot (72 inch widths) of raw* artist's-weight canvas by the foot.
- Your canvas has to be a **minimum** of 6 inches longer and wider than your stretcher for stretching (8 inches would be better.)
- The canvas would need to be 7 feet x 6 feet (7' by 6' or 84" x 72") for the stretcher as originally sketched unless we change the dimensions.
- **If the stretcher was 5' 6" or 66" we could use a 6' x 6' canvas.**

* *Don't use primed (pre-gessoed) canvas: It's much more expensive and harder to stretch.*



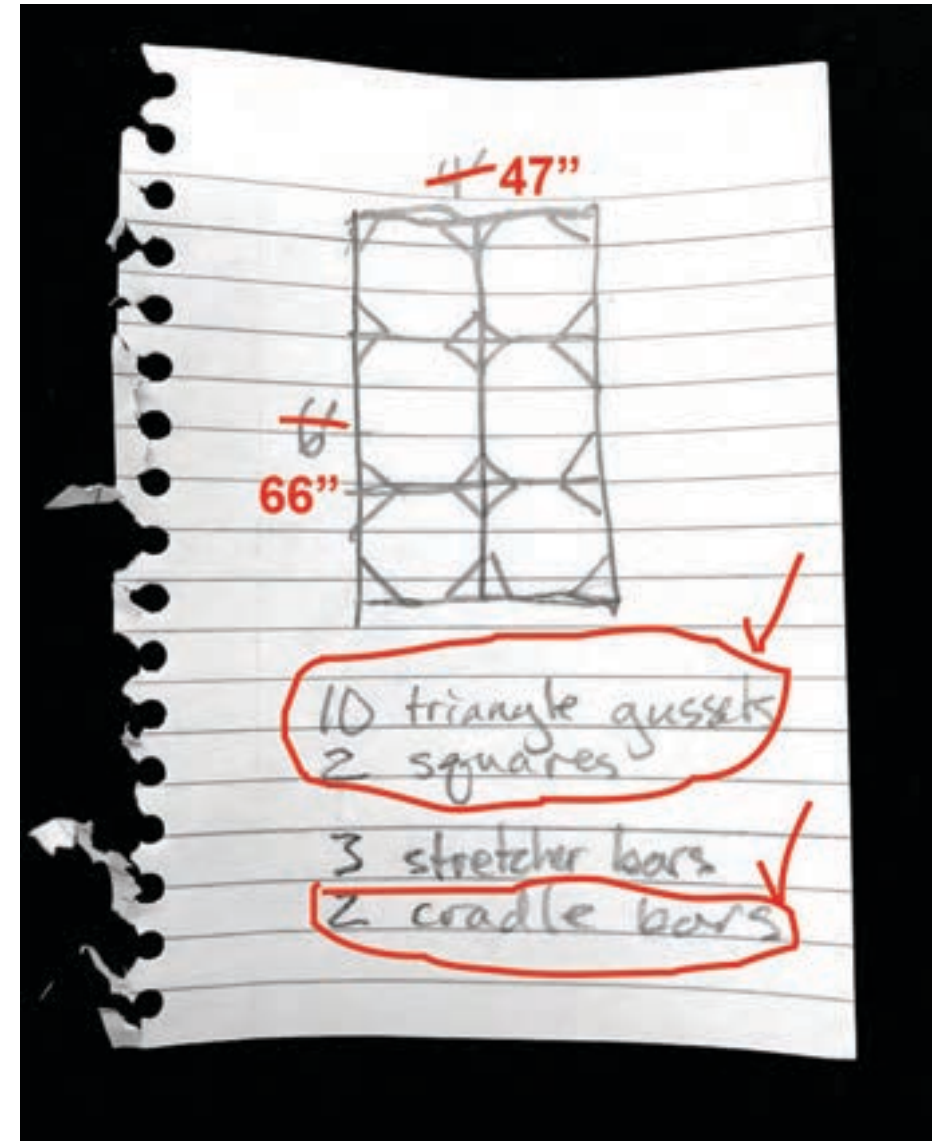
PLANNING BY BARS

- The stretcher and cradle bars are 8' or 96" long.
- Because we will waste some of that length when sawing the angles at the corners, it's always a good idea to make your stretcher size a little smaller to fit into the bar lengths.
- For the 4' or 48" lengths, if we made them 47" we could fit two lengths into one 96" stretcher bar.
- We'll also need a whole stretcher bar for each of the 66" sides. This makes the project total 3 stretcher bars with a bit leftover.



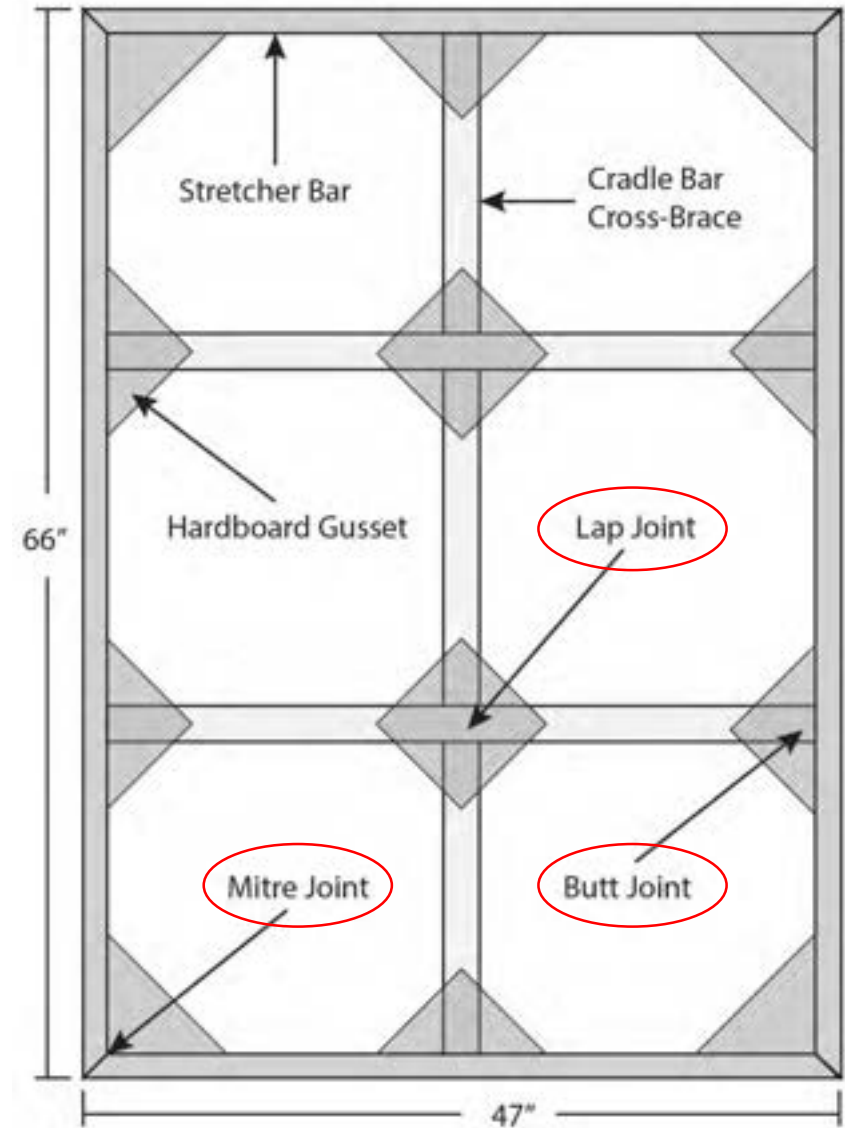
CROSS-BRACING & GUSSETS

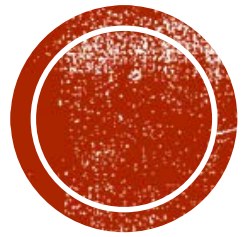
- For every span larger than 2' (24") you need a cross-brace going from one side of the outside frame to the other. This keeps the frame from twisting or collapsing when you stretch the canvas on it.
- For our frame, we'll need two cross-braces a little smaller than 47" and one smaller than 66" so we'll need 2 cradle bars.
- Every corner and crossing is supported by triangular or square gussets. We'll need at least one 48" x 7.5" hardboard gusset strip and maybe a bit of free scrap from the shop.



JOINERY

- Here are some details from a tech sheet with the 4 x 5-1/2' stretcher showing the bar sections and construction.
- Notice that there are three different types of joints connecting the bars -- 45° mitres for the corners, 90° butt joints connecting cross-bracing to the outside frame and lap joints where the cross-braces cross.
- Next, we'll be going over the use saws in the Department Woodshop for cutting the bars and gussets: a hand mitre frame and two types of electric mitre saws.





CUTTING

Give yourself at least an hour for the first time: Don't rush!

And don't worry – you'll get full instructions and supervision in person!

WORKSHOP SAFETY FIRST!

- You must make an appointment by email < steven.nunoda@ucalgary.ca > before coming to the shop to build a stretcher. Submit your completed questionnaire at the same time.
- When you come to the shop to work, wear sturdy, closed-toed shoes, long pants and nothing in the way of clothing or jewelry that might catch. Long hair must be tied back.
- Put a pair of safety glasses on as soon as you enter. When you leave, put them in the used glasses bucket for sanitization.
- Don't use mobile devices except to take reference pictures or display plans etc.. No calls, texting, videos or earphones.
- You are expected to have already completed your Departmental Safety Orientation and be familiar with the Workshop Rules.

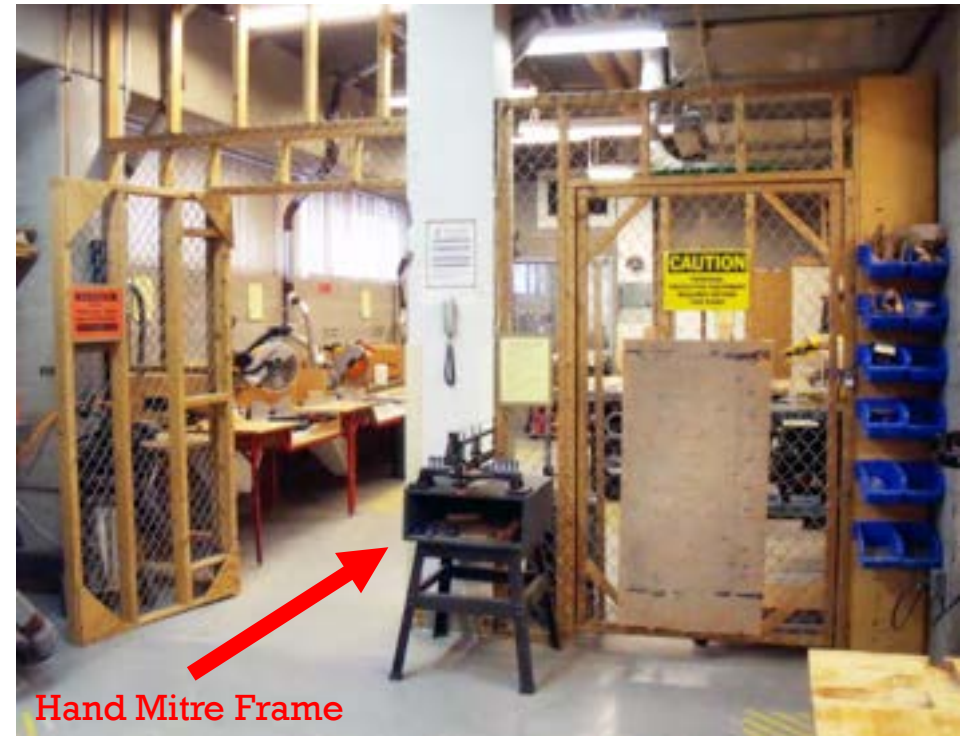
 **Be familiar with the current COVID-19 regulations:** Wear an approved non-medical mask at all times on campus, observe 2 metre social distancing and follow the disinfecting protocols.

 **The shop is currently restricted to occupancy by no more than 7 people.**



THE SAW CAGE

- Check in with a tech first before any operation! If a tech is not available you can't use the machines.
- Before working in the cage, turn on the red exhaust fan switch by the shop door and put on a pair of earplugs.
- The saw cage holds the 3 power mitre saws, the table saw and some other stationary tools. It's separated from the rest of the shop floor for safety reasons.
- Never approach people operating the saws. Wait at the gate until they finish their cut to avoid startling them.
- When you enter, close the gate behind you.

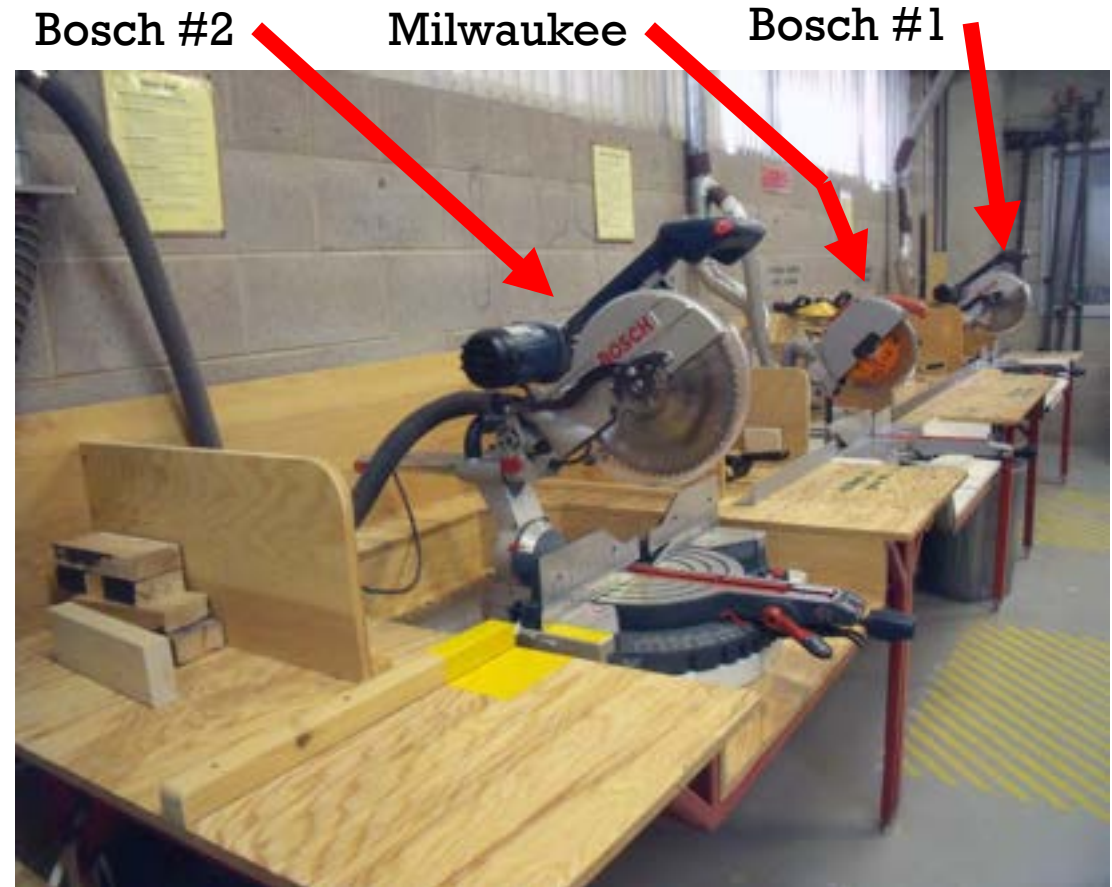


- Put a face shield on when you enter the cage: There's a potential for flying debris. When you are finished cutting, deposit the shield in the used glasses bucket by the shop door.



MITRE SAWS

- Always read the yellow *Safe Operating Procedure* placards before using any machines in the shop!
- Two of the saws in the cage are Boschs with 12" blades. One is a Milwaukee with a 10" blade.
- If you are by yourself in the cage, you can set up and use all three saws. This will cut down your work time and improve your accuracy (fewer re-sets.)
- Note that the mitre saws are only for use with clean, squared wood.

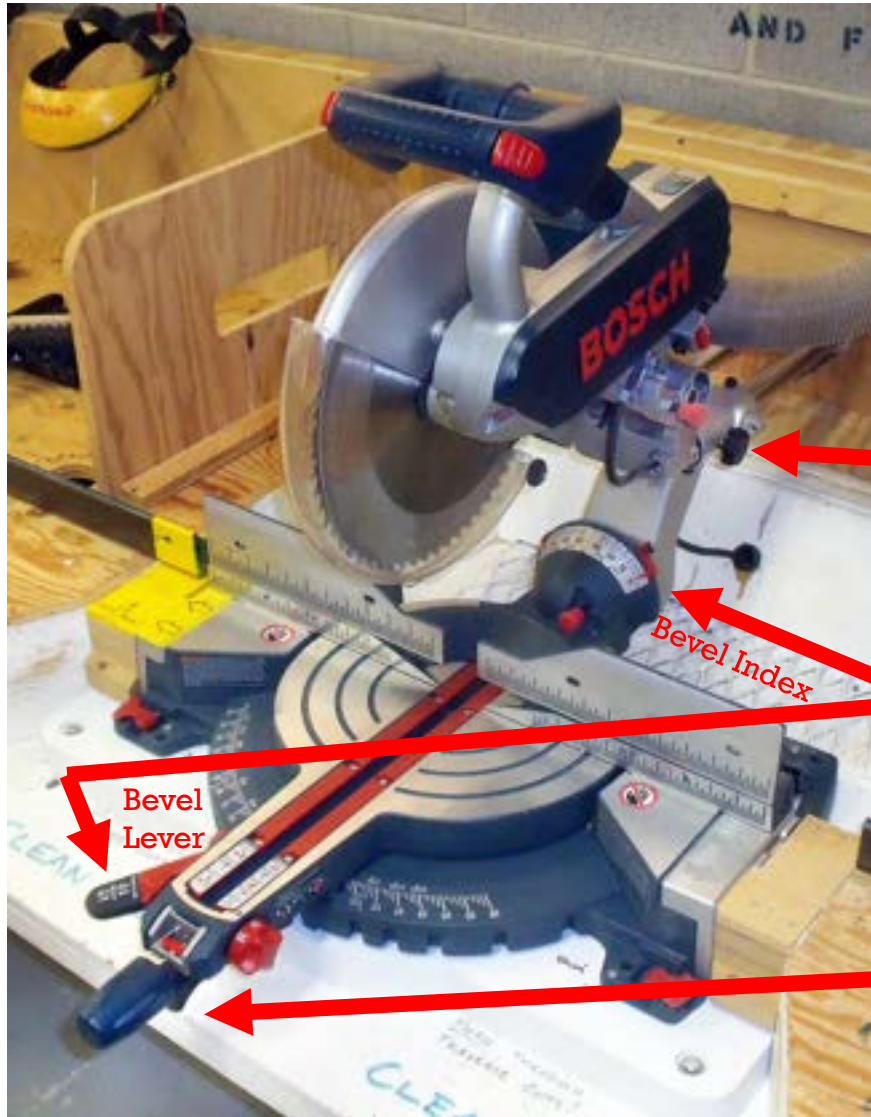


 **COVID-19 Protocol: Wipe down all touch surfaces before and after use!**



BOSCH MITRE SAWS

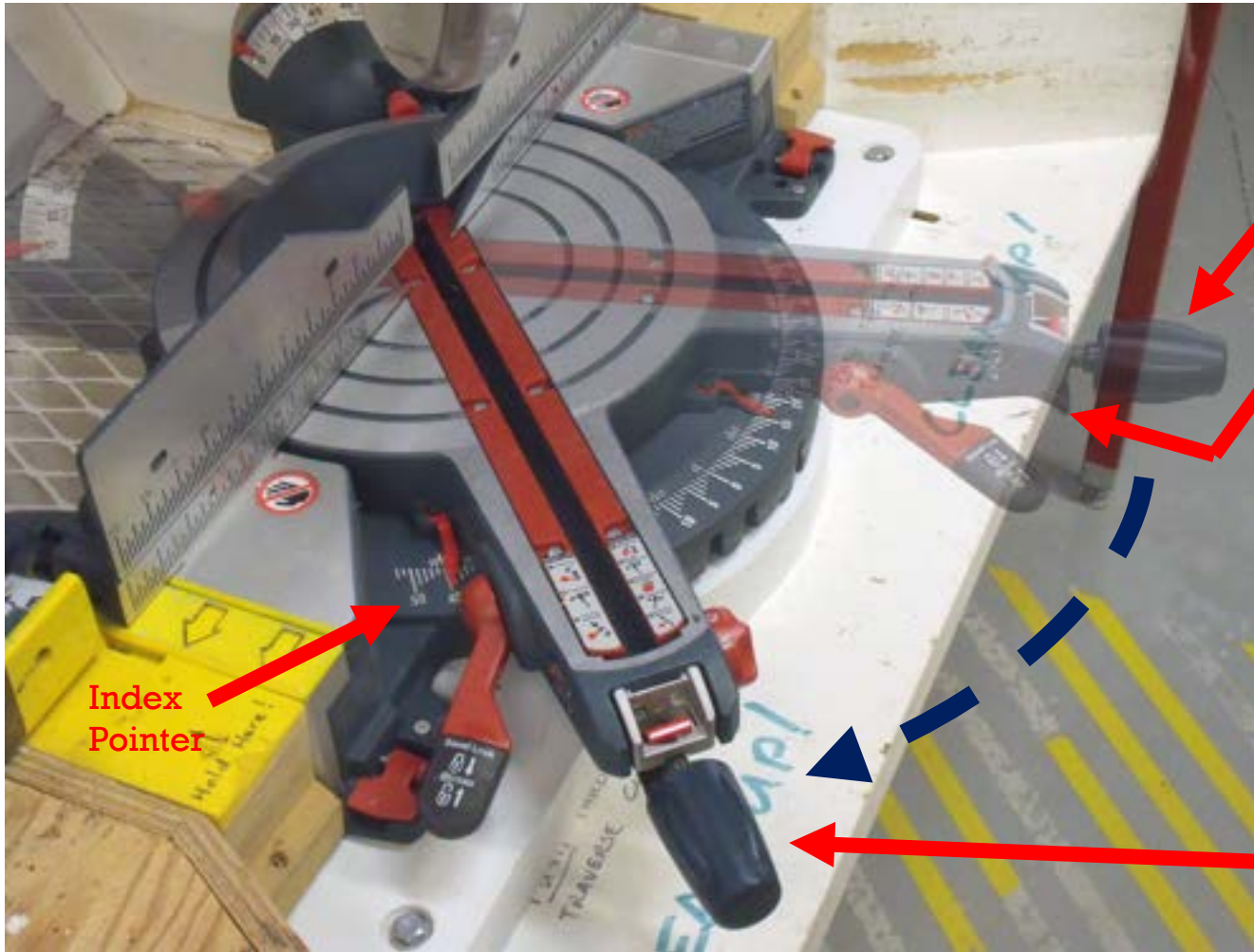
- There are three control adjustments on each of these mitre saws.
- **Check all three in order every time you set up the saws– don't trust the last user!**



1. **TRAVERSE KNOB:** This allows the saw carriage to slide out for deep cuts. Loosen it for our first cuts. Tighten it when not needed.
2. **BEVEL INDEX & LEVER:** The saw carriage can tilt over for compound mitre cuts. You won't need this: Check that the index is 0° and press down firmly on the lever to lock it.
3. **MITRE LOCK-KNOB & TRIGGER:** These allow the saw carriage to swivel for angled simple mitre cuts. Instructions are on the following page...



SETTING THE MITRE ON BOSCH #1



- a. Loosen the lock-knob counter-clockwise.
- b. Pull up on the trigger under the mitre track, grasp the track and slide it toward the desired angle (45° left for our first cuts), reading at the index pointer.
- c. Release the trigger just short of the mark and push the track the rest of the way listening for a click.
- d. Tighten the lock-knob clockwise.



Check all three adjustments!

MILWAUKEE MITRE

1. TRAVERSE KNOB: Loosen for your first cuts. Tighten when not needed.
2. BEVEL KNOB: Tucked away under the exhaust hose at the back. Make sure the index is at 0° and check that it's tight.
3. MITRE LOCK-KNOB & TRIGGER :
 - a. Loosen the lock-knob counter-clockwise.
 - b. Pull the trigger up, grasp the mitre track and slide it toward the desired angle: 0° as shown for the first cross-cuts. Read the angle at the red index pointer on the left side of the track.
 - c. Release the trigger short of the mark and push the track the rest of the way listening for a click.
 - d. Tighten the lock-knob clockwise.

Index
Pointer



TRAVERSE CUTS ON THE BOSCH

- You'll need to use the traverse or slide function on the mitre saws to cut the gussets.
- The traverse order of operations has 6 steps that you need to do as separate motions.
- Practise these before cutting (illustrations on following pages).

1. Hand position

4. Lower the saw

2. Traverse out

5. Traverse in

3. Start the saw

6. Stop the saw



TRAVERSE CUTS ON THE BOSCH



1. **Hand position:** Place your left hand in the yellow safe zone where you will be holding your material. Place your right hand on the yoke.



TRAVERSE CUTS ON THE BOSCH



2. **Traverse out:** With your right hand, pull the saw carriage out until it stops.



TRAVERSE CUTS ON THE BOSCH



3. **Start the saw:** Pull the safety thumb switch in and squeeze the yoke trigger to start the saw. Listen for it to come to full speed.

Safety
Thumb
Switch

Yoke Trigger



TRAVERSE CUTS ON THE BOSCH



4. **Lower the saw:** With the saw running at full speed, push down on the handle until the saw stops in the track. This will start the cut. The blade guard will automatically open as you push down.



TRAVERSE CUTS ON THE BOSCH



5. **Traverse in:** Slide the saw carriage back until it stops in the track while maintaining downward pressure.



TRAVERSE CUTS ON THE BOSCH



6. **Stop the saw:** Release the trigger (1) and raise the handle up (2).



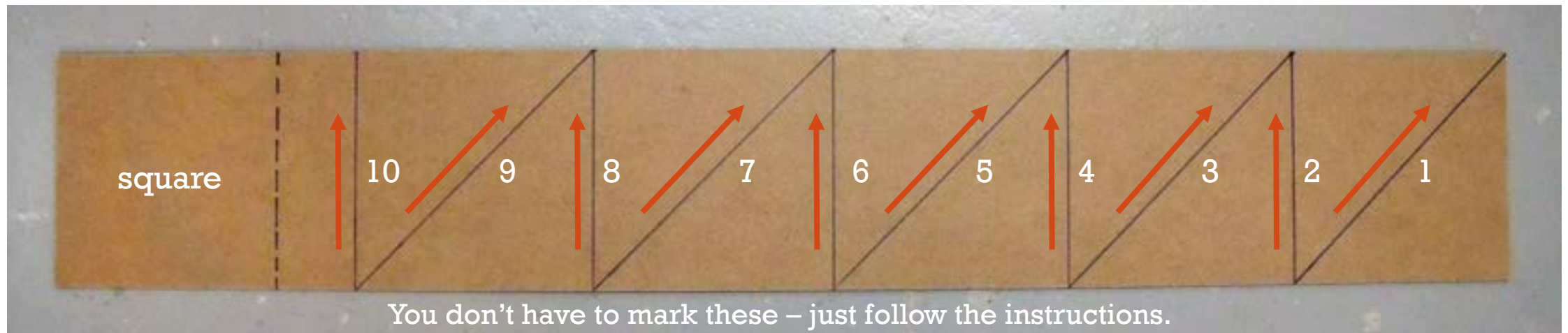
TRAVERSE CUTS ON THE MILWAUKEE

- The steps are much the same for traverse cuts on the Milwaukee.
- The only differences are in the handle shape and the trigger (no safety switch).



GUSSET CUTTING

- Now that Bosch #1 is set at 45° Left and the Milwaukee is set at 90° (0° on the scale) we can cut gussets. We need 10 triangles and 2 squares for the planned stretcher.
- Starting with the Bosch, we'll alternate between the two saws, repeating until the remaining piece is too short to hold on to in the safe zone.
- You can safely get 10 triangles and a square out of a gusset strip and there's almost always free scrap available for the remaining square.



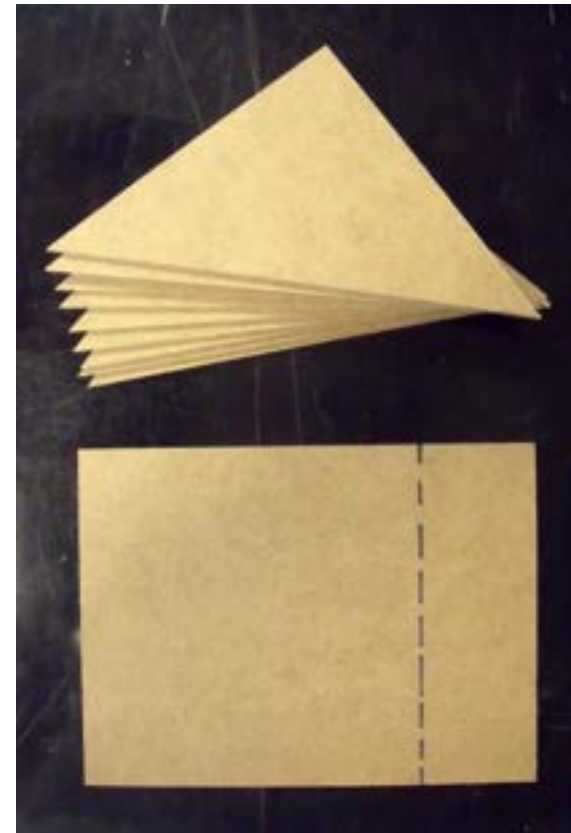
GUSSET TRIANGLE CUTTING

- To begin, lay the gusset strip flat on the Bosch #1 saw table and flat against the fence, with the top right corner between the red runners (circled), then perform a traverse cut as practised.



GUSSET TRIANGLE CUTTING

- Move to the Milwaukee and cut. Repeat this sequence until the strip is too short to hold in the safe zone of Bosch #1. You will have cut 10 triangles and a leftover rectangle.



GUSSET SQUARE CUTTING

- Measure off a square on your remaining rectangle and cut it on the Milwaukee.
- Help yourself to gusset scrap from the scrap box to cut your last square.



- If the scrap box is empty, ask Steve for more.



STRETCHER BARS: RE-SET THE SAWS

- Without touching the triggers, push the saw carriages on **Bosch #1** and the **Milwaukee** all the way back and **tighten the traverse knobs** -- you won't need to traverse anymore.
- **On Bosch #2:**
 - tighten the traverse
 - check and tighten the bevel and
 - set the mitre at 45° right.
- Note that the two Boschs are now set at opposite angles. Each stretcher bar of your frame will be cut on the right end with Bosch #1 and on the other end with Bosch #2, angling the ends towards the centre as in the image on the following page.



STRETCHER BARS: INWARD TAPER

- When cutting your bars remember:
The mitre angles always taper in towards the slot!



STRETCHER BARS: CUTTING STEPS & TRIMMING ON BOSCH #1

- When cutting mitred stretcher bars you'll always do three steps:

1. TRIM

2. MEASURE

3. CUT TO LENGTH

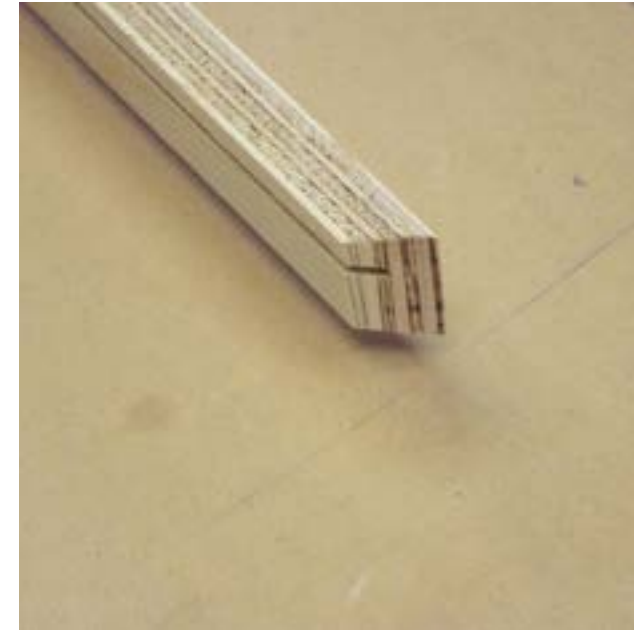


- Check the ends of the bar for faults or damage that needs to be cut off.
- On Bosch #1, place the bar flat on the saw table and flat against the fence **with the bevel edge up and the slot towards you** as shown.
- Now you're ready to trim the right end at 45°.



STRETCHER BARS: TRIM (CHOP CUT)

1. Hand Positions: Left hand firmly holds the material in the safe zone, right hand is on the yoke.
2. Start the saw and let it come to full speed.
3. Bring the saw slowly down until the saw stops in the track
 - A slow cut leaves a sharp clean edge.
4. Release the trigger and wait for the saw to stop before raising the handle.



STRETCHER BARS: MEASURE

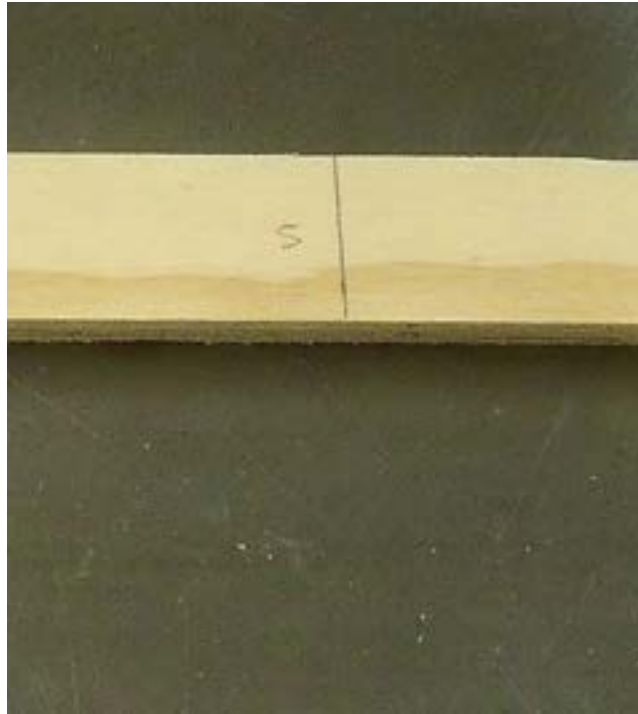
- Lay the bar slot side down and with a tape measure your length **from the trimmed corner.**
- Start with your shorter length: 47" for our stretcher.
- Mark at the top of the bevel edge with a sharp pencil.



STRETCHER BARS: MARK

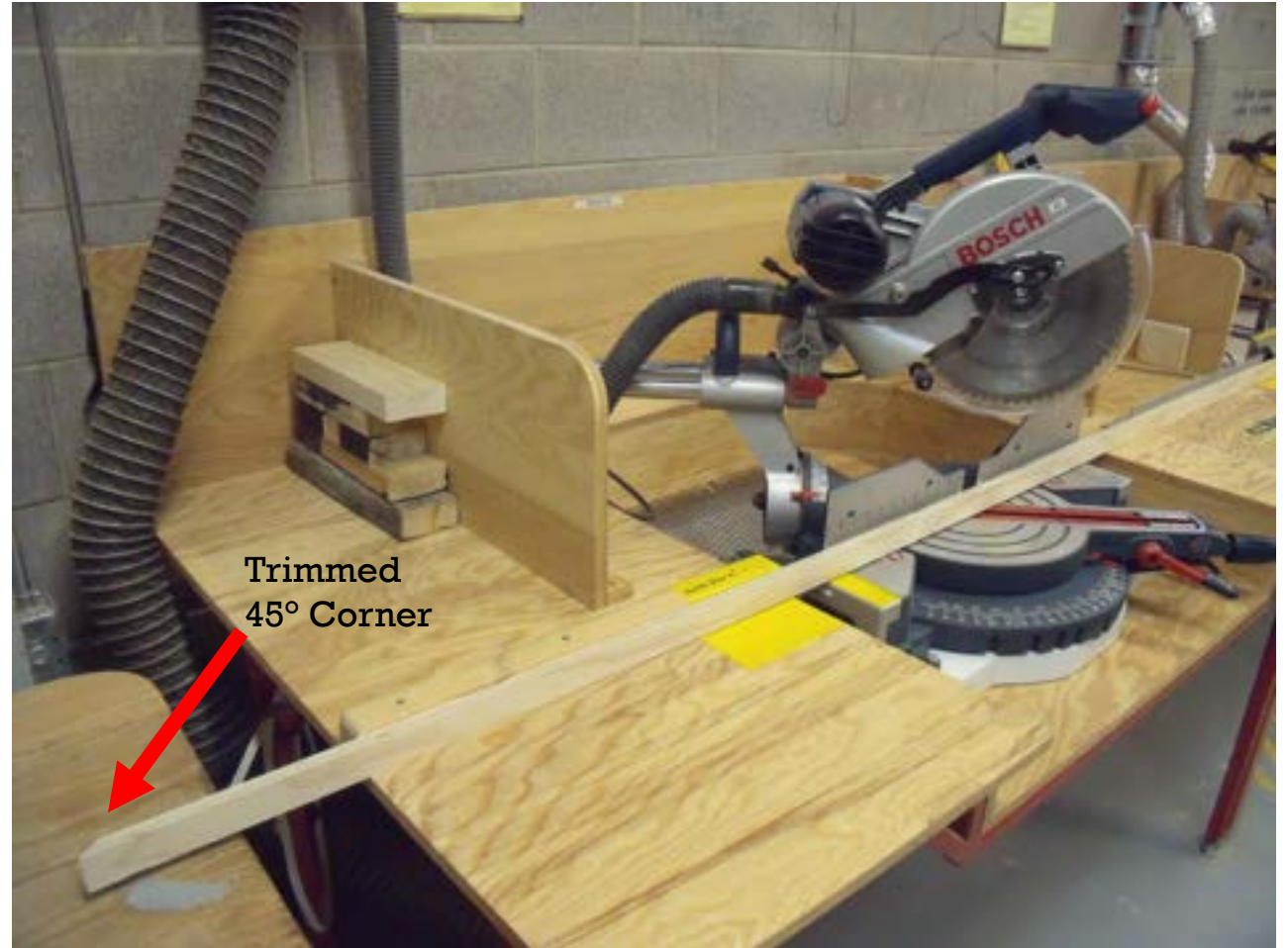


- Use a square to extend the line across the back side of the bar.
- Put an “S” on the scrap side of the line.



STRETCHER BARS: CUT TO LENGTH

- Set-up: On **Bosch #2** place the bar on the saw table **with the bevel side up and the slot side at the back**.
- You have rotated the bar 180° end-to-end so the trimmed 45° corner is on the left.



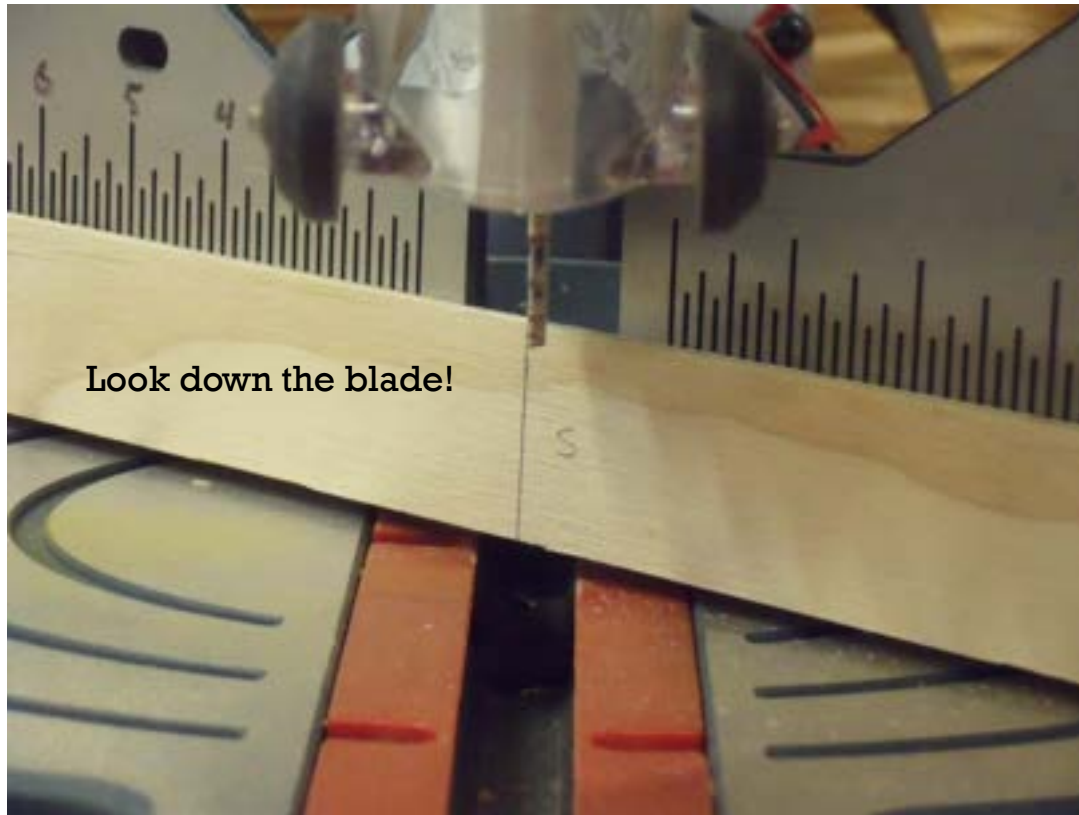
STRETCHER BARS: CUT TO LENGTH

- Line up your mark with the saw blade so the pencil line is touching the left side of the blade. Take your time and be accurate! You can lower the saw blade to touch the mark by pushing down on the yoke, **being sure to not touch the trigger and safety switch.**



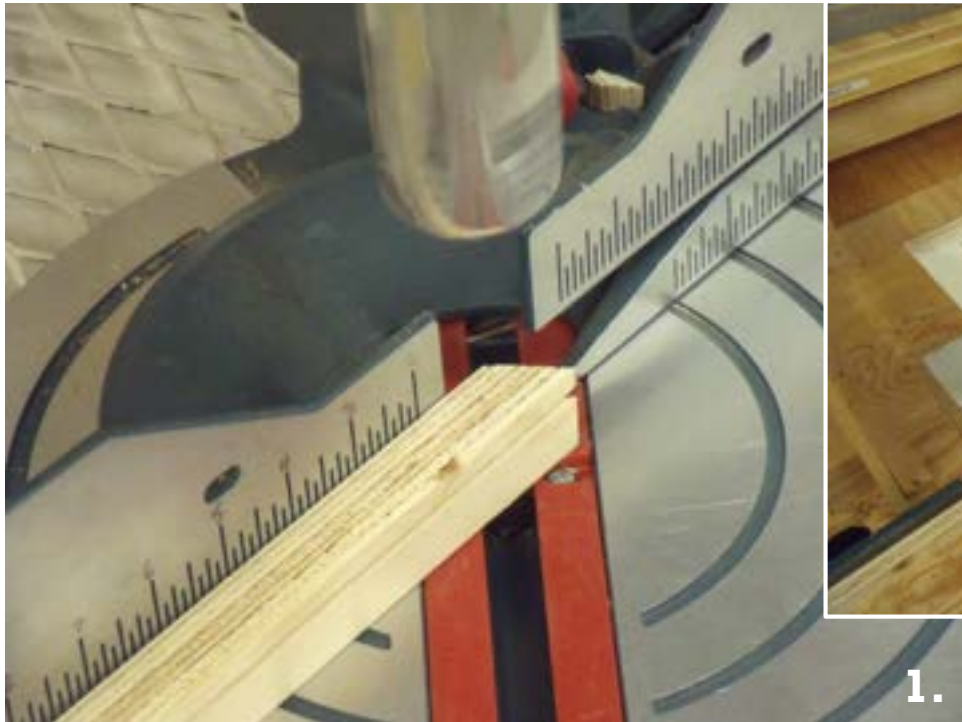
STRETCHER BARS: CUT TO LENGTH

- When correctly lined up, perform a slow chop cut. You can then put an “R” on the finished bar for “reference”.



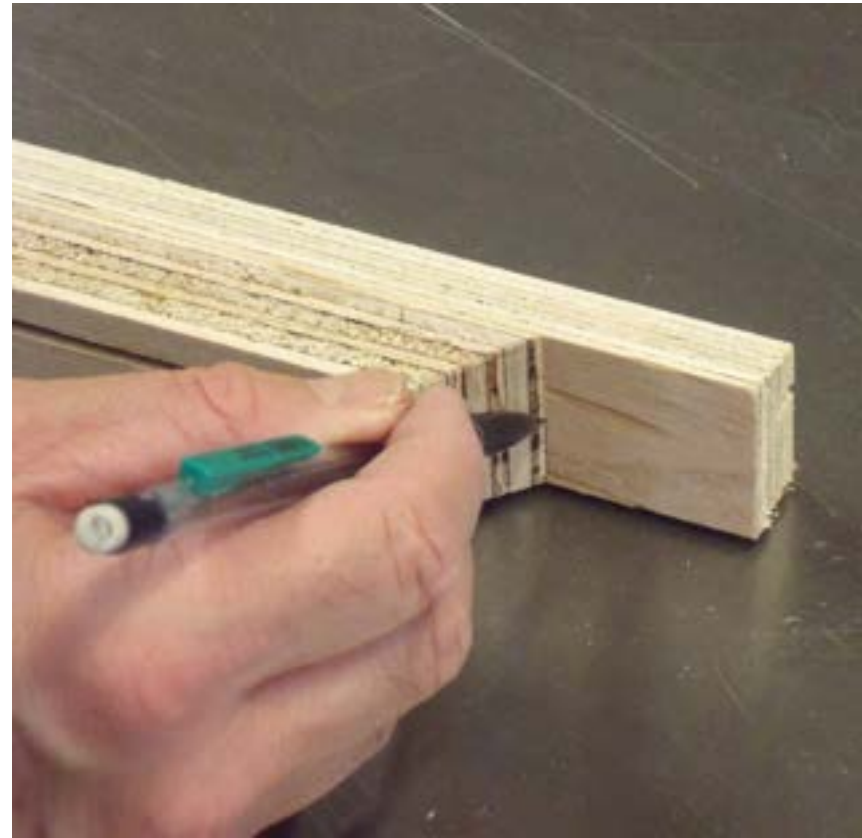
NEXT STRETCHER BARS: TRIM

- On Bosch #1, trim the angled end of the remaining bar with the bevel edge up and the slot towards you.
 - You should have a nice sharp corner



NEXT STRETCHER BARS: MEASURE

- Place the trimmed bar back to back with your reference bar, pinch the centre together and trace the length as shown. The arrow on top indicates the direction of the mitre cut.



NEXT STRETCHER BARS: CUT TO LENGTH

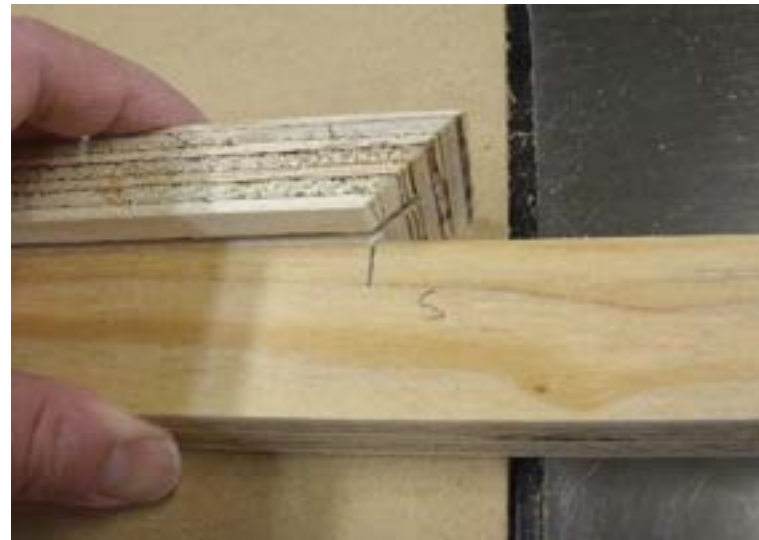
- Rotate the trimmed bar so that the **bevel edge is up and the slot is at the back.**
- Carefully line up the mark on Bosch #2 like the last time and cut.
- Use the back-to-back method to check that both bars are the same length.
- Next, measure and cut the next two long sides (66") from separate bars in the same way and you're done cutting stretcher bars.



CROSS BRACING: MEASURING & MARKING



- For your 47" x 66" frame, you will get two short cross braces out of a length of cradle bar and one long cross brace from another length..
- Against the inside of your short reference stretcher bar, place your cradle bar with the left end touching the inside edge of the mitred angle.
- Grip along the length of the bar and move to the right end of the stretcher bar. Make a mark on the cradle bar at the inside edge of the mitred angle. Mark the scrap side with an "S".



- Flip the bar end to end and make a second mark as above for the other short brace.
- Using a 66" stretcher bar, mark another cradle bar for the long brace as above.



CROSS BRACING: CUT TO LENGTH

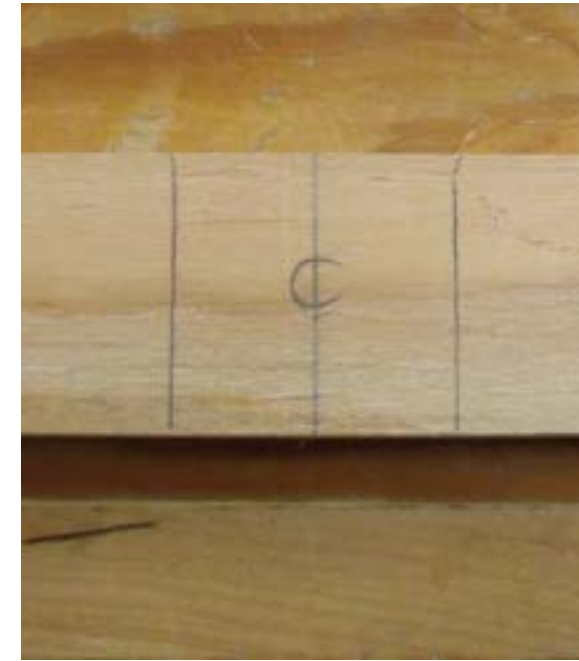


- Line up your bars on the Milwaukee as shown at left with the pencil line just touching the left side of the blade pre-set at 90°.
- Chop cut the three bars to length.
- Move your parts out to the benches then sweep up the machines and Saw Cage floor.



CROSS BRACING: LAP JOINT MARKING

- Measure your bars and mark the centres where the bars will overlap with a “C”:
 - centre of the short braces – about 22 inches in from the end,
 - 21 ½” in from both ends on the long braces
- Use the stretcher marking jig to mark each joint as shown.



CROSS BRACING: LAP JOINT CUTTING 1



Jigs and tools for lap jointing

- **On the hand mitre frame**, line up with the blade directly on top of the pencil line.
- Hold the material on the saw as shown and **cut half-way through the bar** – three laminations (layers) down – with a flat back-and-forth motion.
- Check the front and back edges of the bar to see if you're through. Repeat for each of the outside marks on the bars.



CROSS BRACING: LAP JOINT CUTTING 2



- Set up the lap joint on a bench in a corner clamp with a scrap of hardboard under it as shown.
- With a 1" wide wood chisel, press into the center of the bar between the middle layers with the corner of the blade touching one of your cuts and the chisel's bevel angle facing away from you.



CROSS BRACING: LAP JOINT CUTTING 3

- Hold the chisel vertically with one hand and strike the butt sharply with a mallet.
- The waste piece should pop out. If not, flip the bar over and try again – DO NOT PRY WITH THE CHISEL!
- Pare any leftover bits downward with both hands on the chisel as shown.



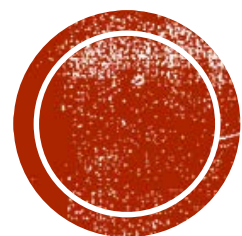
CLEANUP WHEN DONE!

- **Now that you're finished cutting...**

- Throw away scrap
- Dust or vacuum all saws and surfaces
- Sweep up the floor

★ **Sanitize all touched surfaces and tools**





ASSEMBLY

Putting it all together will take up to an hour the first time.

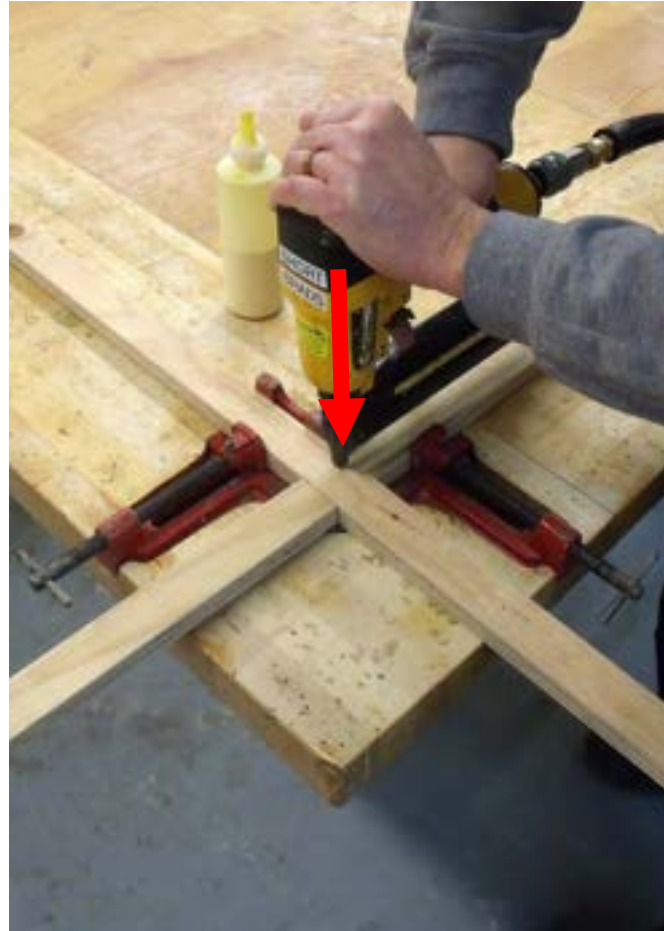
TOOLS



- All the assembly will be done with wood glue and pneumatic brads. The brad-nails hold the pieces together while the glue sets.
- The **grey** and **orange** brad guns will be connected to the yellow full pressure hose. They contain **long brads** (1").
- The **yellow** and **blue** brad guns will be attached to the orange or blue medium pressure hoses and contain **short brads** (5/8").
- You'll also need wood glue, a corner clamp, pencil, tape measure and a carpenter's square.



BRAD GUN SAFETY



- Always operate the brad guns while wearing safety glasses and earplugs.
- You will be given in-person instructions on hose connection.
- Operate with both hands on the gun.
- The gun tip must be pressed against a surface to depress the safety tab and enable the trigger.
- The gun must be lifted free of a surface to reset between firings.



CROSS BRACING: ASSEMBLE LAP JOINTS

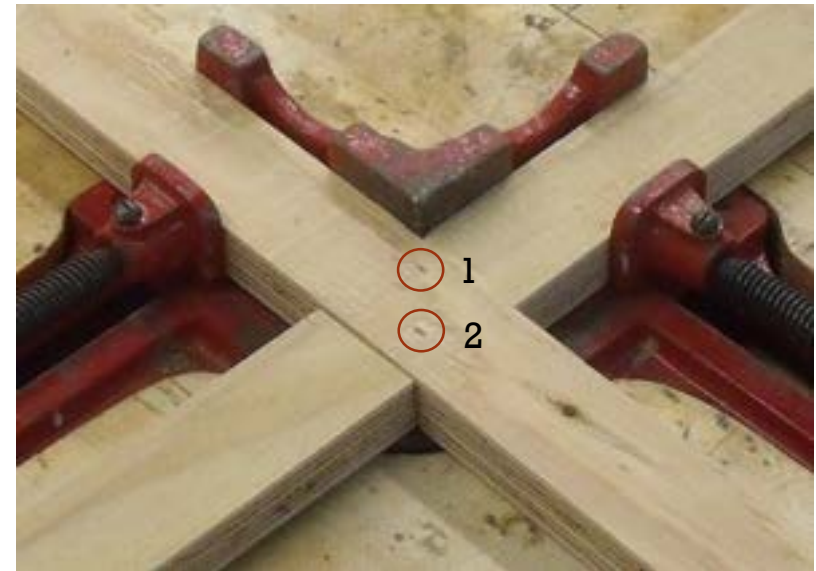
- Set the corner clamp by placing the two bars as shown and tightening.
- Loosen and remove the shorter bar.
- Apply glue to all inside surfaces.



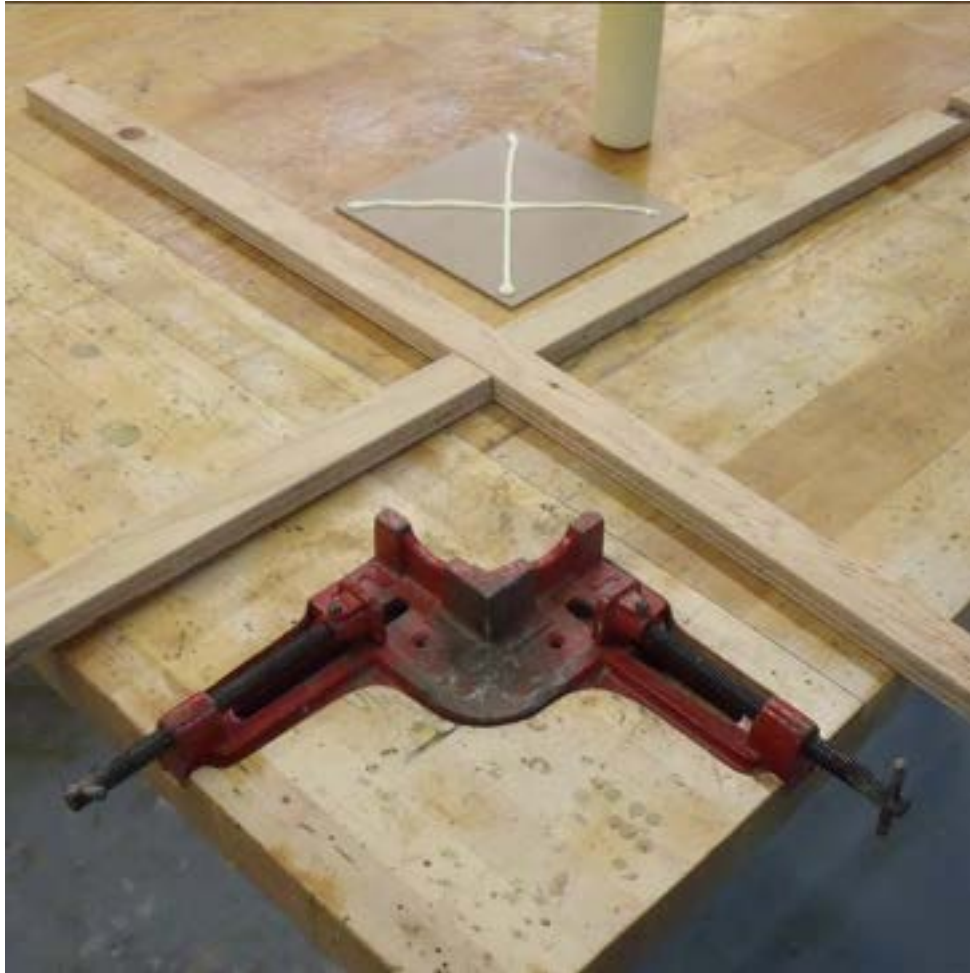
CROSS BRACING: ASSEMBLE LAP JOINTS



- Replace the bar in the clamp and tighten.
- Fire two short brads into the joint diagonally.



CROSS BRACING: ATTACH GUSSETS



- Make a glue “X” on a square gusset from corner to corner.
- Press the gusset down centred on the lap joint as shown.



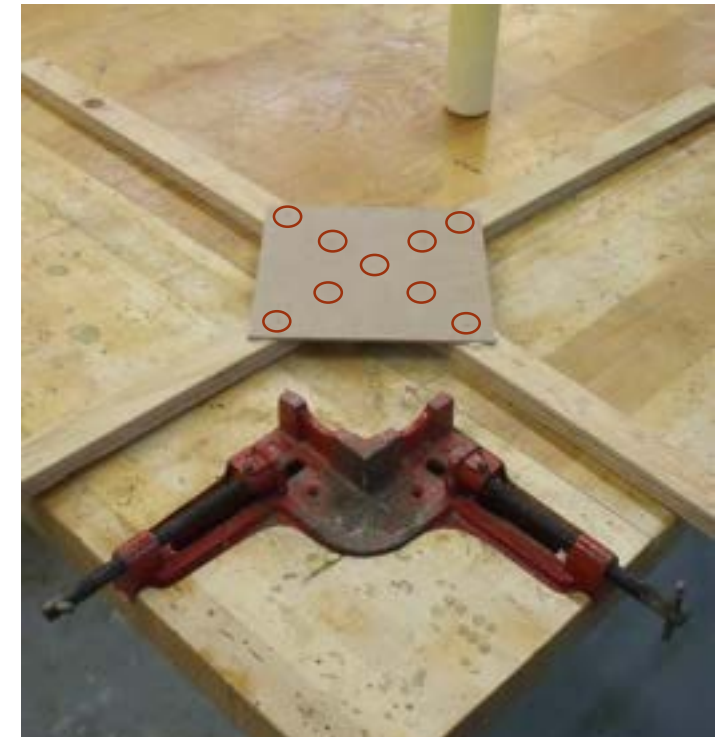
CROSS BRACING: NAILING GUSSETS



- Fire the first brad in one corner. The cross-brace is heavy enough that it won't need clamping.



- Fire into the adjacent corner. The gusset will stop sliding around.



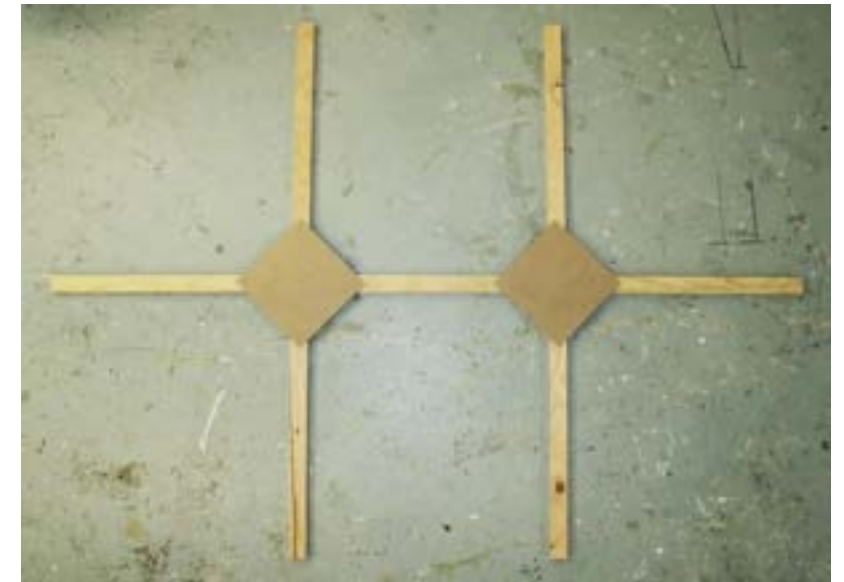
- Finish with brads in these positions -- nine in all.



CROSS BRACING: ASSEMBLE LAP JOINTS



- Repeat assembly steps on the second lap joint.
- Set aside your complete cross brace to dry flat.
- Move on to the stretcher frame!



FRAME ASSEMBLY: BENCH SETUP

- If your stretcher is going to be 5' on a side or larger, you may have to push the benches together or use an adjustable “bench slave” to support your frame while assembling.
- It's important to be efficient with the following steps: You want to complete the frame assembly before the glue is completely set in 20 – 30 minutes after your first glue joint...



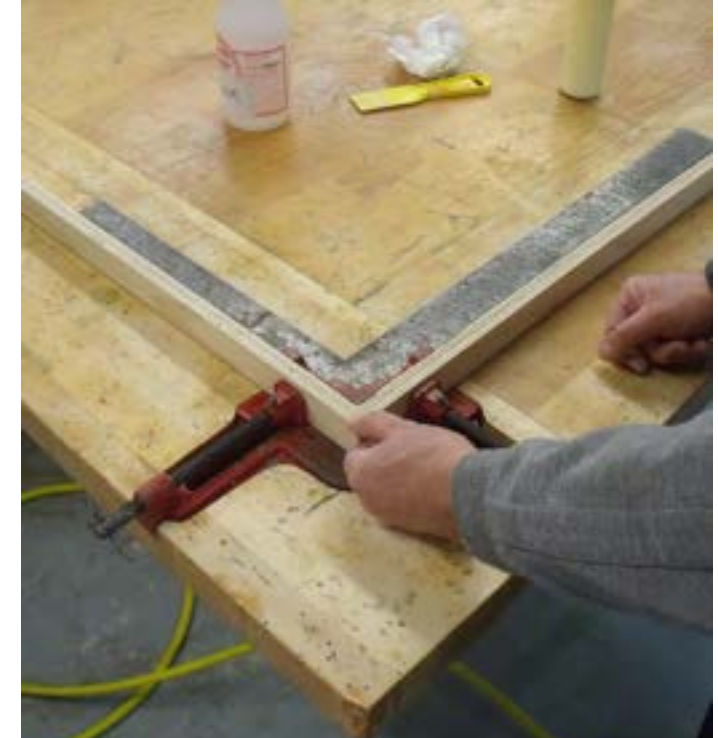
FRAME ASSEMBLY: SET CLAMPS



- Set up the bench as shown with the carpenter's square in the notch of a corner clamp.



- Pinch the bars so they meet evenly at the corner and tighten the screws to set the clamp.



- Use your thumb to check that the bevel edge meets evenly and adjust if needed.



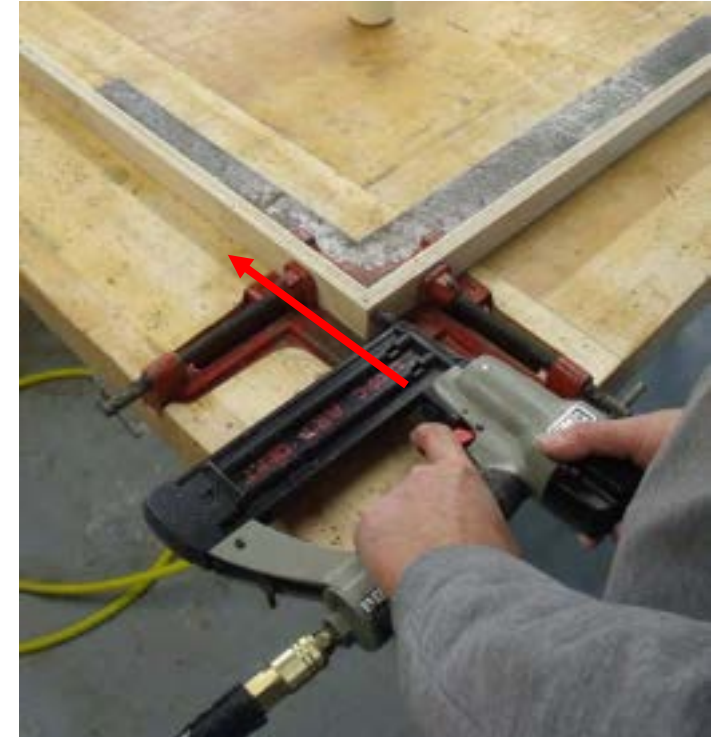
FRAME ASSEMBLY: GLUE & NAIL MITRE JOINT



- Loosen the short side and apply glue to the end. Replace in the clamp and check the alignment.



- Place the safety tab on the corner and shoot a 1" brad **below the slot**, aiming straight into the bar.



- Switch your hand positions and shoot a brad **above the slot**.



FRAME ASSEMBLY: SQUARE UP



- The brad holes should look like this. The brads will hold the joint together while you move the frame...



- Support both bars and place the frame into the square. Both legs should contact the inside edges of the square.



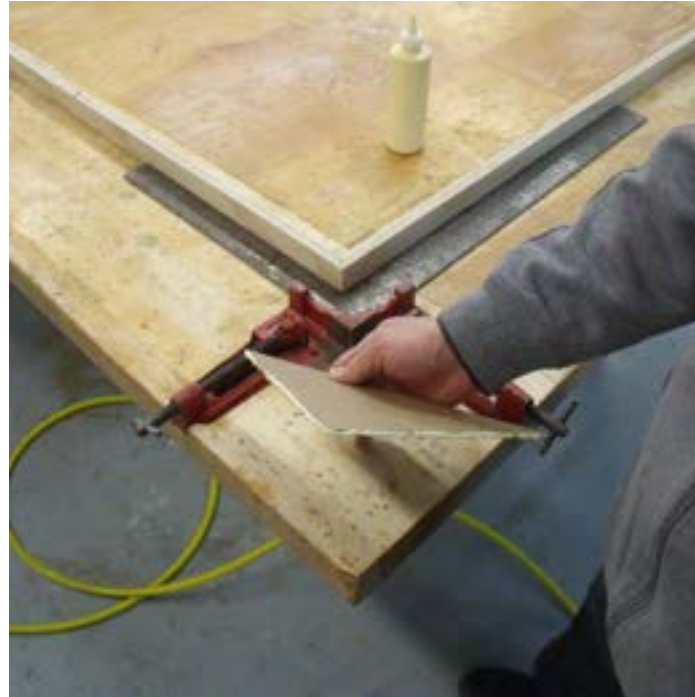
- Here's a reverse angle: Note that the bevel edge and slot line up and the brads are not sticking into the slot.



FRAME ASSEMBLY: GLUE GUSSET



- Right after you nail each joint, fasten in a gusset: It's what keeps the mitre joint square.



- Glue the two short edges.



- Slip the gusset into the frame slot as shown.



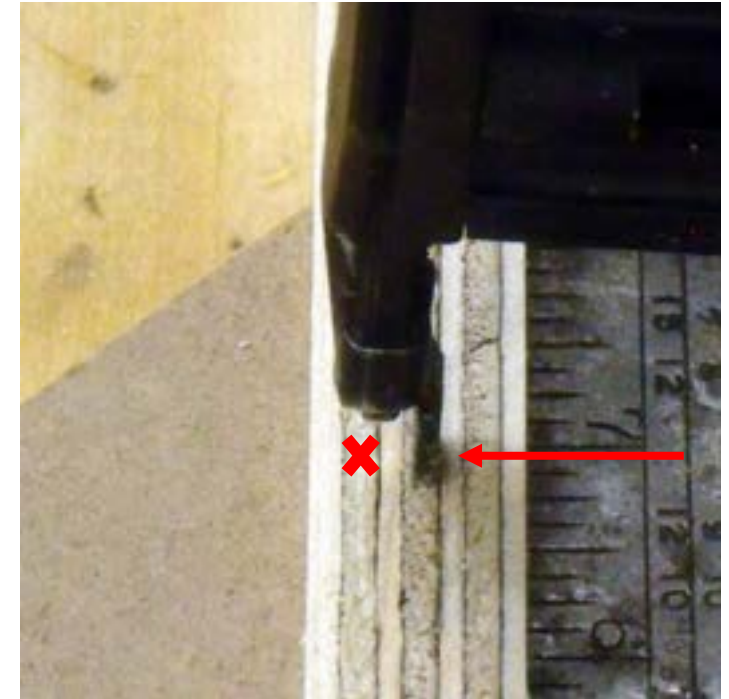
FRAME ASSEMBLY: SET & NAIL GUSSET



- Set the gusset in the slot pulling back firmly so the frame corner pushes against the square.



- Secure the gusset with four 1" brads in the locations shown.



- Line the gun up straight up and down with the safety tab on the middle lamination so you fire into the second lamination.



FRAME ASSEMBLY: ADJOINING CORNER



- Rotate the assembly and set up the adjoining joint, repeating the process. Alternate your lengths long-short-long-short.



- On the last corner, support the joint and the frame as you rotate.



- Lift one side up a little to glue it and finish as you did with the others.



FINAL ASSEMBLY: MARKING



- To fit the cross-brace to the frame exactly mark a centre-line on the short sides. For our example frame, make a mark $23 \frac{1}{2}$ " from the outside edge.



- Mark the other sides as well in thirds. For our frame, mark $21 \frac{1}{2}$ " from the inside of the corner.



FINAL ASSEMBLY: CLAMP SETUP



- With the cross brace centred on the mark, clamp down the parts. If the stretcher frame is bowed you may need to snug up the end of the brace or bend the frame out a little to fit.



- When setting the clamp, line up the brace so that it is at or below the bottom edge of the slot. If it blocks the slot, the gusset won't fit.



FINAL ASSEMBLY: GLUE & NAIL THE BRACE



- Glue and nail each butt joint joining the cross brace to the frame. Often it's easier to glue from below then retighten the clamp.



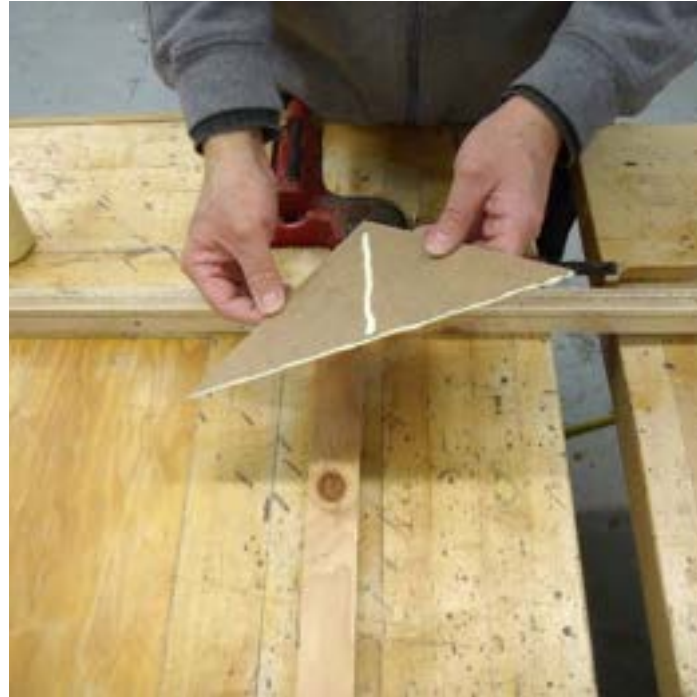
- Fire one 1" brad below the slot to pin the brace in place. Rotate the frame and repeat.



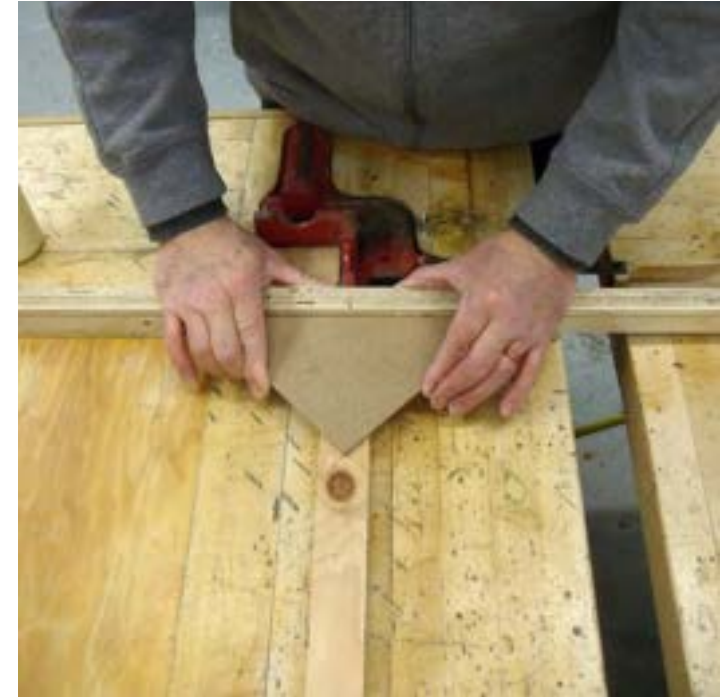
FINAL ASSEMBLY: GLUING THE LAST GUSSETS



- Steady a butt joint against a clamp as shown.



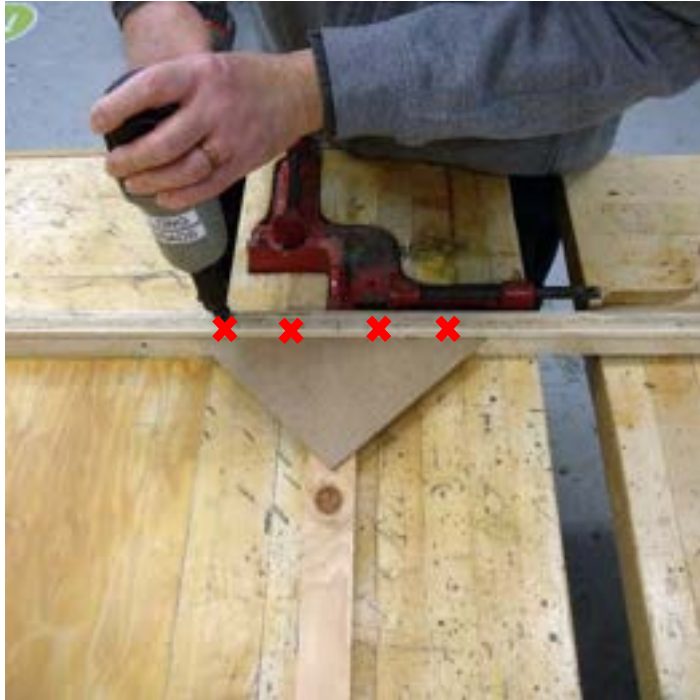
- Glue a gusset on the long edge and across the back.



- Press the gusset firmly into the slot with the point centred on the brace.



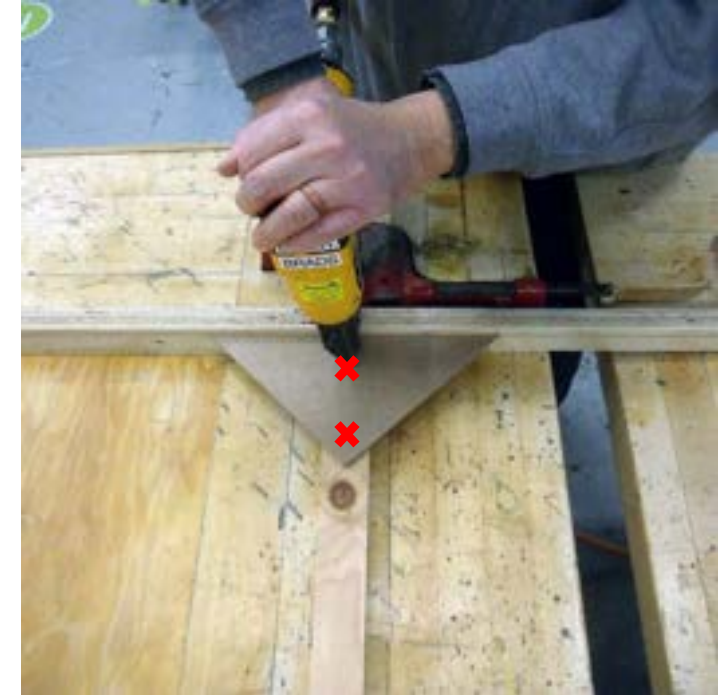
FINAL ASSEMBLY: NAILING THE LAST GUSSETS



- Lining the gun up as you did in the corners, secure the gusset to the frame with four 1" brads as shown.



- **SWITCH GUNS** or you'll nail your frame to the table!



- Secure the gusset to the brace with two 5/8" brads. Repeat for the remaining five brace joints.



CLEANUP WHEN DONE!

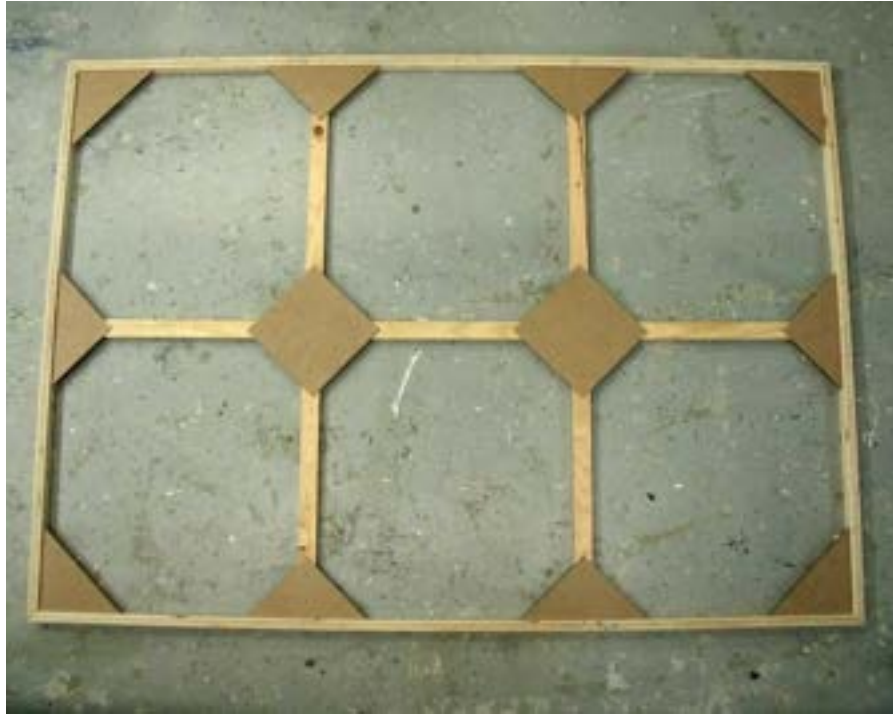
- **Now that you're finished building your stretcher...**

- Scrape and wipe up glue drips.
- Sweep up any scrap.
- Pay for your materials.

★ **Sanitize all touched surfaces and tools.**



ALL DONE EXCEPT FOR STRETCHING



- Place your stretcher on a flat surface for **at least 24 hours** to let the glue cure before you stretch canvas on it.



- If you don't have horizontal space, lean your stretcher against a wall with both top corners touching and the bottom parallel to the wall for **at least 24 hours**.
- This will prevent it from developing a permanent twist.

Remember: Complete and submit your questionnaire and request a shop appointment by email to <steven.nunoda@ucalgary.ca>.

