

Student Sample: Grade 12, Informative/Explanatory

A high school senior wrote the essay that follows for a career and technical class. The student had unlimited time to research and write this paper.

Wood Joints

Have you ever wondered how to design complex wood joinery? The types of wood joinery have been around for thousands of years. There are only twelve different main types of joints but there are many that combine more than one for aesthetics or strength. The first step in designing joints is understanding the different types and what their uses are. After you understand the strengths and weaknesses of the different joints you can compare and contrast the joints for aesthetics. This and a lot of practice are what make excellent wood joinery.

The first step in designing joints is to figure out what way the wood will move so it won't destroy the joint. Then figure in the stresses that will be put on the joint. The three types of stresses on joints are compression, tension, and shear. Compression is the weight pushing down on another piece and making it crush down. Tension is things being pulled apart. Shear is when a piece breaks off when overloaded.

There are two categories of joints there are sawed joints and shaped joints. A sawed joint is one that can be cut in one pass with a saw. The shaped joints can be complicated and take multiple cuts. Joints are either made to lock together which are the shaped ones or to make glue surfaces to glue together which are the sawed ones. The twelve types of joints are the butt joints, miter joints, rebate joints, dado joints, groove joints, and lap joints are sawed joints. Scarf joints, finger joints, dovetails, mortise and tenon, dowel joints, and spline joints are shaped joints.

To lay out good joints there are a few tools necessary. You need a good square that is accurate, a steel ruler for measuring, a miter square, a sliding bevel, a protractor, and a caliper. The square is to draw perfect ninety-degree lines. The miter square is so you can check your miters for accuracy. The sliding bevel and protractor is to draw angles other than forty-five degrees. The caliper is to make sure the pieces getting joined are the right thickness.

For a good joint the fit should be tight. But if it is too tight it is not good because the wood joint could crack or break. It should be tight enough that you can either push it together or give it a light tap with a hammer to seat it. Another reason it can't be too tight is because when the glue is applied the wood will expand. Then it may not fit. The reason the wood expands is because putting the glue on is like putting water on it.

The way to make a tight joint is in the layout. A marking knife is a lot more accurate than a pencil. Also make sure you use the same ruler throughout the project because there could be slight variations in different ones. Always mark the waste side of the line and make sure you follow on the right side of the line. If you cut on the wrong side of the line it will not be tight enough.

Now that you know what tools to use the next thing in tight joinery is to make sure all the pieces are the same thickness or the thickness needed. Boards should be cut to a rough length so they are easier to run through the machines. This will leave less room for error because the pieces won't be so bulky. Also make sure that the plywood is the thickness it's claimed to be because it could be off 1/64 of an inch. Whenever possible trace the mate for the joint to ensure a good fit.

If the joint is cut too small there are four different repairs. You can fill small gaps with a mixture of sawdust of the same species of wood and glue. For loose parts you can add shims and sand or file to fit. You could also make a design feature for loose parts. A slot cut in the end of a loose tenon with a wedge put in it makes a nice design feature. But if it is real noticeable you should just replace it. When buying lumber, always make sure you buy a couple of extra boards for mistakes or defects you didn't notice when you bought it.

Out of the twelve different joints, I'll start with the ones easiest to make. Butt joints are the easiest joints to make. A butt joint is wood joined face to edge or edge to end. There are several ways to attach the two pieces. They can be nailed or screwed together but should have a pilot hole drilled or the pieces may split. Corrugated or metal fasteners can be used. Also you can make wooden triangles or blocks to

strengthen up corners. The pieces can also be doweled together, which is one of the stronger ways to attach the two pieces. The two pieces can also be biscuit jointed together which is another fairly strong way to attach them.

Another fairly simple joint is the lap joint. The lap joint is where the two pieces of wood to be joined are cut so only half the thickness of each piece is left. They are then glued, nailed, or screwed together. The lap joint is mostly used for frames that will have plywood on them. The joint is also used in latticework, which is used for decoration in different pieces of furniture. The downside to this joint is that it isn't very strong but it does look nice in some applications.

The next joint is a little more complicated but still fairly simple. The only thing complicated about the miter joint is figuring out the angles for different shapes. A square is simple but you have to make sure the saw is exactly square or the joints won't fit tight. But as you get into different sided shapes the angles are harder to figure out, especially if they have to be a compound miter. That is where it is cut on an angle in two different directions. The miter joint looks good because there is no end grain but it isn't very strong. But biscuits can be added for some extra strength.

The next joint is the dado joint. Dados are slots cut across the grain. They are cut using a dado blade in the table saw, on a router, or hand chiseled. The uses of a dado are for putting shelves in the sideboards of a bookcase or other piece of furniture. The dado can be stopped short of the edge of the board to form a stopped dado. This is useful when you don't want the joint to be seen.

A joint similar to the dado is a groove. A groove runs with the grain instead of against it. There are several ways to cut a groove. You can use a dado blade, router, molder, or shaper. A groove is usually used in making raised panels. It is what holds the pane in between the rails and stiles.

A joint similar to a groove is the spline. The spline joint can either be a solid spline like tongue and groove. That is where one board has a groove and another one has a piece with both edges are cut off leaving the middle. A loose spline is a board with two grooves cut and then a piece of wood inserted in the two grooves and glued. The uses good for the spline is siding and paneling. It also works fairly well in making large panels because the tongue helps to keep the boards aligned. You can dress up the spline joint by putting a chamfer or bead on the edge of the boards.

A good joint for joining backs to furniture is the rebate joint. It also works well for joining the tops and bottoms of furniture. A rebate joint is a dado at the end or edge of a board and usually has a piece of wood in it the same thickness as the dado. The wood is usually nailed or screwed into place. Another version of the rebate joint is one that is stopped. The stopped rebates are used when you don't want the joint to show.

A joint that can be quite complicated is the scarf joint. The scarf joint is used to make two boards into a longer one. This joint is mostly used in timber frames. The joint came around in Europe when they had cut all the long big trees down and had to find a way to make the long beams needed for their buildings (Ramuz, 279). Then when the settlers came to America, they didn't need it for another hundred years or so until they did the same thing over here. The joint is usually about eight times longer than the width of the board or beam. It is made to have a lot of glue surface to make it a fairly strong joint. But it is not as strong as a full-length board or beam.

Another joint that can be quite complicated until you have the jig made for it is the finger joint. The finger joint is easy once the jig is made you just have to stand at the table saw and keep running the boards over the dado blade. The finger joint is several grooves on the end of a board with the other board cut to mate. They are very strong because it really increases the glue surface. The joint can also be used as a hinge if the corners are rounded and a dowel put all the way through the joint.

The last two joints left are some of the most complicated ones to design and cut. These joints are the real give away of quality joinery. If these joints are done properly they can last for hundreds of years and will really make your work look professional. The two joints are the mortise and tenon and dovetails. You can either cut these by hand or machine. If cut by machine, they aren't as complicated to make as they are when you cut them by hand. The joints aren't cut by hand as much anymore, but when they are you can take more pride in your work.

I will start with the mortise and tenon. The mortise and tenon has been around for hundreds and hundreds

of years. There are many uses including timber frame, attaching aprons to the legs on tables, and attaching rails and stiles on doorframes. Mortise and tenon are very strong joints. The timber frame barns and buildings are still standing after hundreds of years. The only reason they fall is because of decay and neglect. The mortise is a square hold cut to a certain depth and size. A through mortise is a square hole that is cut all the way through the board or beam. The tenon is the mate to a mortise. It is a square cut on the end of a board or beam. They are usually in the center of the board but can be offset if there is going to be more than one joint in the same spot. It also could be offset if it was going to be close to the edge of the other post or leg. A through tenon can look good with a wedge, or you can peg the tenon for strength. Mortises can be cut with a mortise, router, or drilled out and squared up with a chisel. Tenons can be cut by router, table saw, or by hand. But whatever way you do it they still mean good quality work.

The other hallmark of quality wood joinery is the dovetail. Dovetails can either be cut by a router and template or by hand with a lot of practice. A dovetail is similar to a finger joint except that it has angles. The dovetail has been around for thousands of years and there is a reason why. It is very aesthetically pleasing and strong enough to last for a very long time. Dovetails are very strong because it is made to pull apart in only one direction so from any other direction it can handle extreme loads.

Now to make dovetails by hand you need to take your time and be patient. They aren't as hard as you may think but does take practice. When the joint is completely cut it should fit together with a light push and should be very stiff. Dovetails are used in making drawer frames and the main box in cabinets. There are two types of dovetails and they are through dovetails and half-blind dovetails. Through dovetails are the ones where both boards go all the way through each other leaving the joint exposed. Half-blind dovetails are usually used to attach drawer fronts to the rest of the frame. On those, only half of the joint is visible because the other half ends short by 1/8 inch or more.

Now that you know the basics, here are a few more things you should know to make strong dovetails. If creating dovetails out of softwood, you should have a slope of 1 to 6 on the dovetails. If making them out of hardwood, the angle should be 1 to 8 (AM-wood.com). The reason for this is because softwood splits easier, this way the dovetail won't spread the wood as much when pulled on. If you are making multiple joints it is better to make a pattern so they are all the same. Plus it won't take as long because you won't have to lay them out every time. Dovetails are made up of two parts and they are pins and tails. It doesn't matter which ones you choose to cut first but you should always trace its mate to get a perfect fit.

That is all twelve woodworking joints. Now lets talk about beefing them up a little. Sure there are nails, screws, and other mechanical fasteners, but I'm talking about shop made ones. Dowels and biscuits are excellent ways to strengthen joints unnoticeably. But wedges, pegs, and wooden blocks are good ways and could even add some decoration. On through tenons, you can cut slots in the end of the tenon and add some wedges as a design and a way to keep it from pulling out. On mortise and tenons you can drill a hole and insert a peg for strength and looks.

To sum it all up there is a lot of information on the twelve different wood joints. Some of them can be quite complicated but with practice you could become an amateur woodworker. I have learned a lot about the different joints and techniques behind them. This research helped a lot in deciding what joints to use and how to construct them for my tech project. My tech project is designing and building a gun cabinet. In my gun cabinet I'm going to use rebates, grooves, dados, lock miters, dovetails, mortise and tenon and lap joints. I hope you have learned as much as I have about choosing and creating joints in wood. There is still more to be learned but this is a very good start in becoming a professional woodworker.

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Annotation

The writer of this piece

- **introduces a topic.**
 - *Have you ever wondered how to design complex wood joinery?*
- **organizes complex ideas, concepts, and information so that each new element builds on that which precedes it to create a unified whole.**
 - *The first step in designing joints is to figure out what way the wood will move so it won't destroy the joint.*
 - *There are two categories of joints . . .*
 - *To lay out good joints there are a few tools necessary.*
 - *The way to make a tight joint is in the layout . . .*
- **develops the topic thoroughly by selecting the most significant and relevant facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.**
 - *If the joint is cut too small, there are four different repairs. You can fill small gaps with a mixture of sawdust of the same species of wood and glue. For loose parts, you can add shims and sand or file to fit. You could also make a design feature for loose parts. A slot cut in the end of a loose tenon with a wedge put in it makes a nice design feature. But if it is real noticeable you should jut replace it.*
- **uses appropriate and varied transitions and syntax to link the major sections of the text, create cohesion, and clarify the relationships among complex ideas and concepts.**
 - *Out of the twelve different joints, I'll start with the ons easiest to make.*
 - *Another fairly simple joint is the lap joint.*
 - *A joint similar to a groove is the spline.*
 - *To sum it all up . . .*
- **uses precise language and domain-specific vocabulary to manage the complexity of the topic.**
 - *Dados are slots cut across the grain.*
 - *A groove runs with the grain instead of against it.*
 - *A rebate joint is a dado at the end or edge of a board and usually has a piece of wood in it the same thickness as the dado.*

- **establishes and maintains a formal style and objective tone while attending to the norms and conventions of the specific discipline in which the student is writing.**
 - *The other hallmark of quality wood joinery is the dovetail.*
 - *My tech project is designing and building a gun cabinet. In my gun cabinet I'm going to use rebates, grooves, dados, lock miters, dovetails, mortise and tenon and lap joints.*
- **provides a concluding section that follows from and supports the information or explanation presented (e.g., articulating implications or the significance of the topic).**
 - *To sum it all up . . . with practice you could become an amateur woodworker . . . There is still more to be learned but this is a very good start in becoming a professional woodworker.*
- **demonstrates good command of the conventions of standard written English (with occasional errors that do not interfere materially with the underlying message).**