How to build

a laminated Glass Bow

2nd Edition

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Design

There are probably at least as many ideas on how the perfect bow should look, as there are bowyers around that build them. Wether a bow is perfect or not also largely depends on what the bow will be used for and who is going to use it.

But there are a number of significant parameters, that help to boost or damp certain characteristics of the bow. To discuss all the different possibilities how to design a bow would be way to much for this book. You also have to consider that bow design has a lot to do with experiences made while building and shooting them and we can't get that just by reading a book. But still, I will try t explain a few of the most important parameters of a good design.

Bow Profile

The bow profile describes the form of the bow when it' ng. T ther with the width and the thickness of the limbs, it's responsib e characteristics of the bow during the draw and the release of the ar

The Straight Longbow (Hill Style B

The straight longbow is the simple bo form a has some advantages, that make it the perfect starting bow. and the straight longbow does have a very smooth initial draw, because t rel of the limbs is not as big as it would be in a reflex, a defle or a rve bow.

On the other hand these bo well tempered nature and less sensitive to an improper shootin

This is due to the fa even glass laminated bows take a little set after they are glued up. So if a is glued up in a straight form it will have a slightly deflexed profile after be g shot in. This will make the bow less sensitive to a sloppy release (I will explain this further in the section about the deflex/reflex profile on page 11 + 12).

But this doesn't mean that this type of bow is only for the beginners. The great Howard Hill was a confessed fan of the straight longbow, why this type of bow is often called Hill style bow.

Unfortunately there are also a few downsides that come with this bow design. The one thing that most people will notice immediately when shooting such a bow the first time is that they tend to have quite a bit of handshock. Another thing is the draw force that does not increase all linear during the draw, but rather strong towards the end and for people with a longer draw length there

even might be some stacking. Sta cking occurs as soon as the string angle at the tips reaches 90° and with straight limbs this happens way earlier than with reflexed or recurved limbs. The third point that can cause some problems is the very narrow and almost flat grip shape of the classical Hill style bow design. The shooter has to be very aware of how to place his hand to be able to reproduce the exact same grip every time he/she shoots this kind of bow.

Picture 3: A classic Hill style longbow

The one advantage that these bows have, is that the form for glueing up the bow is easy to build. No need to cut any curves and radiuses, that makes it much less complicated compared to a form for a deflex/reflex or a recurve bow.

It's also a lot easier to fit the riser piece to the form. Instead of sanding the riser piece until it fits perfectly, just cut it on a circular saw and you're ready to glue it up.

Bow Grip

The grip is probably the most underestimated part of a bow. A lot of peoples forget that it's the link between the archer and the bow and that it's abloutely critical for good and constant shooting. On one side the bow should lie absolutely stable in the hand of the archer, but on the other side the grip should also be loose and not to tense.

To get good results and make quick progress it is very important that the hand of the archer holds the bow always exactly at the same place and in the same way.

Locator Grip

This grip has underneath the shelf a more ore less pronounce grip and helps to lead the hand of the archer always in the same

Picture 10: Locator grip of a deflex/reflex longbow

The locator grip is probably the grip form that is used most commonly on longbows, because it helps a lot to always getting the same grip.

The straight Grip

This grip form is still used a lot on Hill style longbows. But contrary to the locator grip it requires an active and concious positioning of the bow hand. Novices or less skilled archers may face some problems to get constant results with a bow with a straigth grip.

Picture 11: A straigth grip of a Hill style bow

With a straigth grip it's much more difficult to place the bow hand always at the same place.

Pistol Grip

The deep cut pistol grip is mostly used on recurve bows. It allows the archer to get a good grip of the bow and supports a streched wrist of the bow hand.

Picture 12: The pistol grip of a recurve supports a streched wrist of the bow hand

The alongated wrist allows the archer to hold the bow only with the thumb and the index. This helps to prevent unintentional canting of the bow. At the same time the bow arm and the bow hand are pointed straight onto the target, wich helps a lot if one is an instinctive shooter.

Reverse Grip

The reverse grip (or forward riser) is built forward on the back of the bow. The limbs are set back a little and therefore it helps to stabilize the bow in the same way like the deflex/reflex profile design does. The reverse grip is commonly used on recurve bows.

Picture 13: The r ip s back the limbs and helps to stabilize the bow du the aw

If we compare the draw curves of the two bows, we can see that the area under the curve of the deflex/reflex bow is bigger. This area represents the energy that is stored in the limbs and it's obvious that the bow with the deflex/reflex profile stores more energy and therefore has better performance/higher arrow speed than a straght longbow.

Calculating the Stack (Glass and Wood)

If the Laminates and the glass is glued up, the draw weight can only be changed in a very limited range. For thas exact reason we need to know the stack thickness (wood and glass laminates) before we glue up the whole thing. With the chart on page 86 we can determine the thickness we need for a certain draw weight.

On a concrete example I will explain in detail how it works, but first have to answer a few questions.

How long ?

The bow should have the look of a classic longbow ar be used on the 3D range and in the woods. For those reasons we decid hat e bow length should be 64 inches.

What type of profile ?

The future owner will use the bow 3D tour ents, so it has to conform to the FITA rules that state that a b is not allowed to have visible reflex in the limbs. We choose a moderate d /refl profile with a total taper of 0.005, so that the limbs bend a bit in t er part according the FITA rules (no visible reflex when strun

What draw wei ?

The future owner of bow wants to be able to shoot it over a longer period without any problems, we decided to go for a target draw weight of 40-45@28. I will tiller the bow approx. to 45@28 and hand it to her so she can shoot it for a while. If necessary I will reduce the weight until she is happy and feels comfortable with it.

What draw lenght ?

The required draw length is 27 inches. I will build the bow, so that it can be drawn up to 29 inches without stacking. To make sure that the lenght of the working limbs don't get to short I will reduce the length of the riser piece to 17 inches (instead of 18 inches). By doing that the lenght of the working limb is only ½ inch shorter that it would be with a bow length of 66 inches.

What kind of wood ?

For the limbs I will use hard maple as core laminations and cocobolo veneers under clear glass.

For the riser I will use cocobolo with some stripes of carelian bi[illegible]. For the riser overlay I will use the same woods. Since cocbolo is a very dense [illegible] heavy wood the riser will have more mass and therefore give the bo[illegible]tability and reduce the handshock.

Now that we have defined the dimensions and the m[illegible]ile o[illegible]w we can start to evaluate the thickness of the lams with the ta[illegible] o[illegible] the ne[illegible] page. First we select the column with the bow lenght (64 inch[illegible]d mark the row with the desired draw weight (45 lbs). To compensa[illegible]the s[illegible]ap[illegible]aper and the shorter riser piece we add approx. 7 lbs (see AD[illegible]MEN[illegible]nderneath the chart). Finally we add another 10 lbs to make [illegible]e we[illegible]s enough room for a correct tillering. So we end up with a theoretical [illegible]w we[illegible] of 62 lbs. In the according row (55/65 lbs) we can see tha[illegible]e n[illegible] a stack thickness of 0.38 – 0.40 inches.

With a stack thickness of 0.[illegible], that equals a draw weigth of 60 lbs, we are very close to our theoretical d[illegible]wei[illegible] of 62 lbs and we should be able to hit the target weight of 45[illegible].

As you can see at the [illegible]n of the chart, the glass should make up 20 – 25% of the stack. Wit[illegible]gla[illegible]e are at 20% and with 0.05 glass we are at 25%. With one 0[illegible]gla[illegible]and [illegible]e 0.05 we would exactly hit the middle, but for reasons of sim[illegible] we choose 0.05 glass for the back and the belly.

Now we can calculate the thickness of the lams: 0.39 – (2 x 0.05) = 0.29 inches (total wood thickness).

For the limbs we use two core lams, two veneers and two unidirectional glass lams. By doing so we can split the total taper on the two core lams.

Where to get the Stuff

Since I don't have the tools to cut my own lams, I buy everything (laminations, glass, phenol stripes and the epoxy) here...

https://binghamprojects.com/

If you want to cut your own lams, you need some serious tools. First thing you need is a qualtity saw (circular saw or band saw) to cut the blanks. Second thing you need is a thickness sander (drum sander) that allows you to sand the lams to the desired dimensions (thickness and taper).

The glass I use is unidirectional Bo-Tuff glass from Gordon. The reason I use this glass is very simple, it's just the best I've ever used. It really brings out the grain of the wood you glued underneath.

I use Smooth On Epoxy, because it gives the best glue join[illegible]lly under clear glass you can see the difference to some other epoxy. I[illegible]re your lams properly then you won't get any bubbles under the [illegible] can[illegible]et it dry and get hard ar roomtemperatur, but you will get bett[illegible]esu[illegible] heatbox.

Building the Form

Before we can start building bows we need to build a form for the glue up. In the appendix I have attached the drawings for the form of the recurve and the deflex/reflex longbow (page 91 + 89).

For this we get ourselves a wood core plywood board with the following dimensions: 78 x 15 x 1.5 inches. I do not recomand the use of MDF because it will not hold it's form, or in worst case even break.

After we have copied the form of the bow onto the board, we can start to cut it out on the band saw. The more accurate we cut the form, the less we have to sand until the form is nice and smooth. With a drum sander even out possible dings and nicks. Do not forget to check, that the drum is adjusted square.

Picture 21: With a dr nder we even out possible dings and nicks

It is important that the curves run smooth and even and that they have no dings. Since the bow will be a exact copy of the form it is clear that more precise we work here, the better the bow will look.

On top of the form we glue a strip of glass, or a metal band, to get a nice and clean surface.

Finally we draw a parallel line, 2 inches away from the outline. On this line we drill wholes with a diameter of ½ inch. In these whole we insert wooden or metal rods that stick out 2 inches on every side of the form. On these rods we'll attach the rubber bands during the glue up

Picture 22: The form is ready for the glue up, now we can start to build the bow

Another possibility to cut the form is the use of a pattern router bit instead of a drum sander. Before we can cut the form we have to cut a template of the form. After we have sanded and cleaned the form of the template, we screw it on the form so that we can use it as a guide for the pattern bit. If the bit isn't long enough we have to clean the surface in two passes. Like this we get a nice and clean surface that is perfectly square.

Of course we can expand the whole form and build it much more comfortable. Then, however, the effort is now significantly higher, because the form now consists of 2 parts that must fit exactly to each other and different metal fittings.

Preparing Lams and Glue

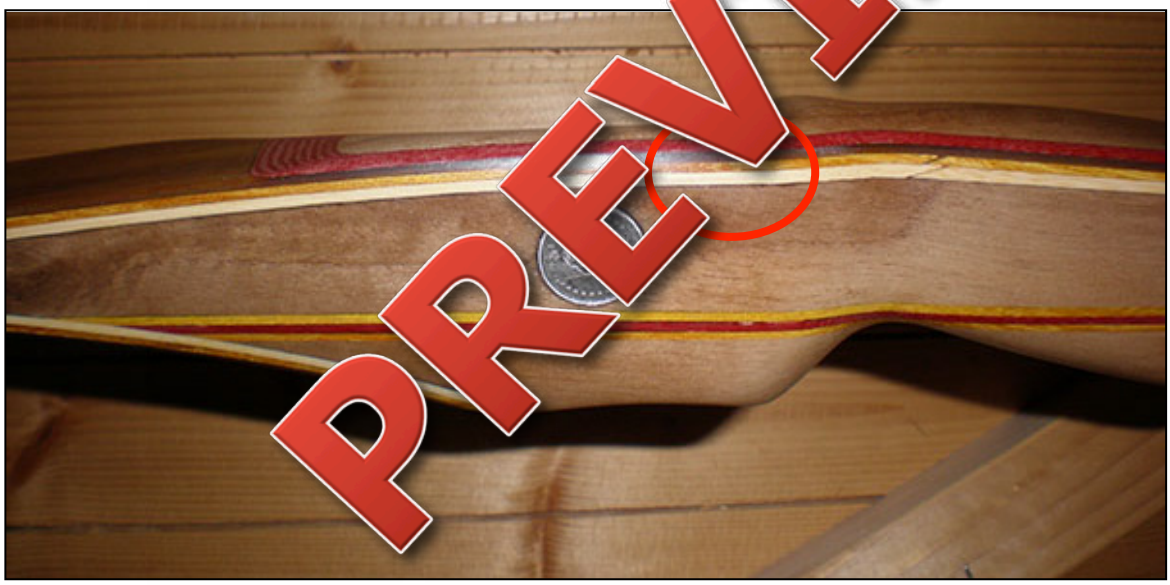
Before we can glue up the bow we need to do some preparational work. First we mask the glossy side of the glass with tape to prevent them from getting scratched. The tape also helps us to avoid that the glass gets soild with glue and therefore we don't have to sand it off afterwards. Instead we just can peel off the tape after the glue has cured.

Picture 32: The tape protects the glass from getting scratched. After the glue up it just can be peeled off.

Usually the lams come in pairs that have a length of about 36 inches. For the back of the bow we need to splice together a pair of veneers and a pair of the core lams. For this we sand the ends of the lams in an angle of approx. 30 degrees and glue them together with super glue. A long metal ruler clamped to the table makes a fine measurement device. It's important that the lams fit together nicely so that they are aligned perfectly straight when glued together. Otherwise we won't get a nice glueline.

Picture 33: With a pair of clamps we fix the lams in place while the glue curing

To prevent the lams from clueing to the table we put a piece plas[illegible] on the table. After the curing we sand off the excess glue to mak[illegible] all fits tighly. Later on the splice will be covered by the overla[illegible] and won[illegible]ely be visible.



Picture 34: The splice is covered by the overlay and is almost invisible

Grinding of the Limbs

Once the center line and the shape of the limbs (width) have been drawn on the tape, we can begin to grind them out. If you can use a big grinding machine it is the easiest way to get along. In a first step we grind away everything outside of the lines, but leave the lines untouched. Both limbs should have exact the same width.

Picture 42: Grinding th

Once we ha grin d bot limbs evenly and clean we can draw the string grooves. For t measure from the center of the bow 32 inches (32 x 2.54 = 83.8 cm) outwa d mark the string grooves at an angle of 45 ° on the side of the limb.

Using a chain saw file, we file the string grooves into the sides of the limbs. It is extremely important that the 45 ° angle on both sides is exactly the same, because otherwise the string might apply a force that pulls the limbs sidewaye and even bend then.

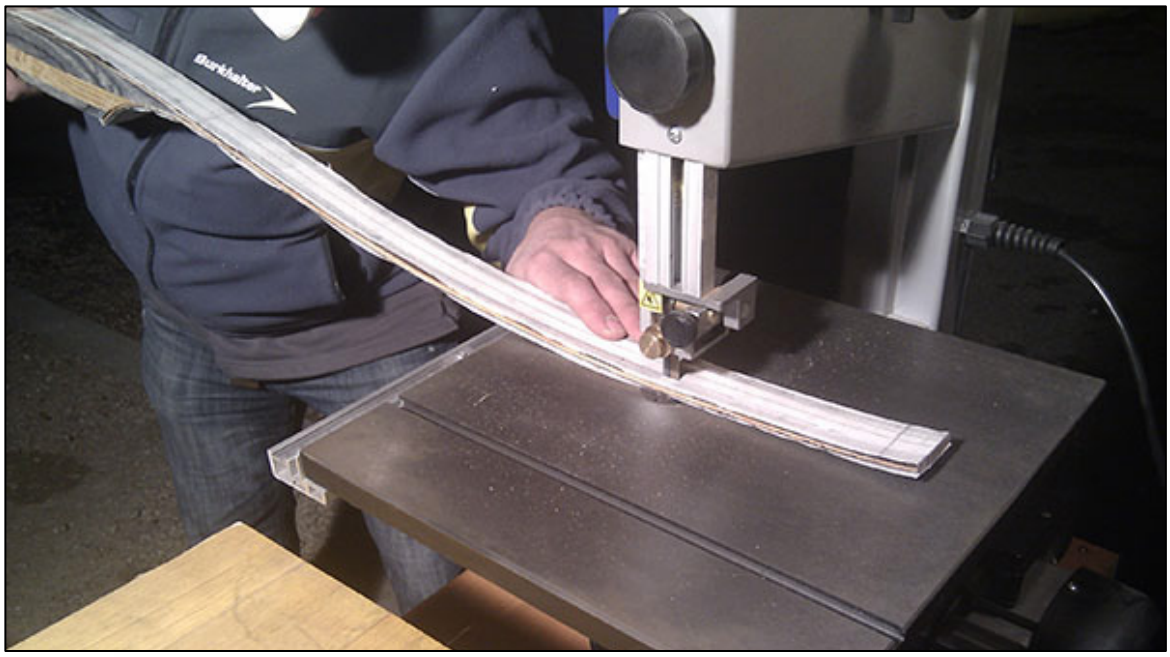
Picture 43: A chain saw file has exact the right size fpr the string grooves

For the moment we file the string grooves only on the sides of the limbs, because we haven't glued on the tips yet. They string grooves should be max. 1.5 - 2.0 mm deep, to ensure that the string doesn't jump out of the groove. Even that the grooves are not finished yet we have to round all edges and sand them smooth or we risk that the string might get damaged.

If we do not have a large belt sandimg machine that we can use, we can saw out the limbs with the band saw. With saw blades for metal with fine toothing I have made the best experience, because coarse blades for wood wear extremely quickly and heat up very much.

The guide on the saw blade must be adjusted so that the blade is guided properly and can not swing always backwards.

Then we carefully saw along the drawn lines. But we just leave the lines standing and do not cut into them. We push the bow very light and tender during the sawing so thet the saw doesen't heat up to much.



Picture 44: Cutting of the limbs on the bandsaw

If you don't have a bandsaw, it's also possible to cut out th h an electric jigsaw. Use a blade for metal with fine toothing b se y best suited for cutting glass lams.

Picture 45: Alternatively you can use an electric jigsaw for cutting out the limbs of the bow

With file and sanding paper we shape the tips into a nice and round form. Don't make the lower tip to pointed, because it might get damaged when the bow is set down on it. With a drum sander and sanding paper we shape the fades of the tips until they blend perfectly into the glass. We do this exactly the same way we worked the overlay on the riser. Be careful not to sand to deep into the glass.

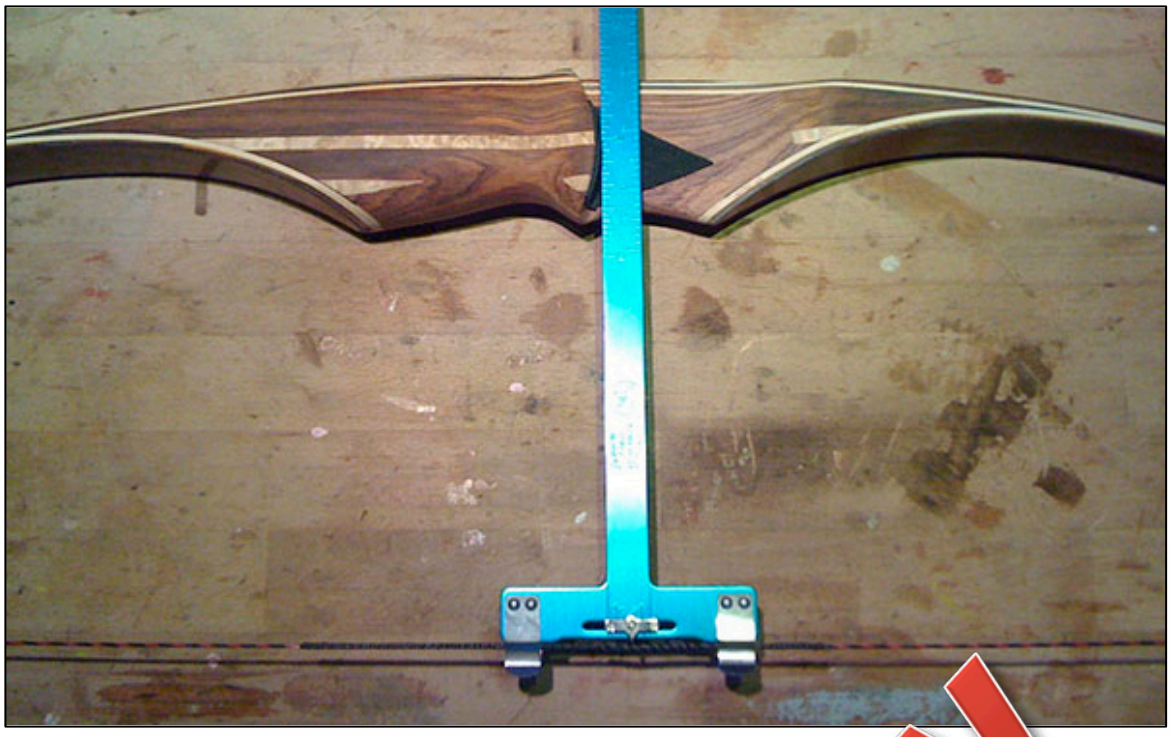
Bow Tuning

Before we can start to shot the bow we have to set it up correctly. The best bow poorly set up with a wrong spined arrow is a catastrophe, while a mediocre bow properly set up with the correct spined arrows can be an absolute pleasure to shot.

IMPORTANT !
Always shot a few arrows to check if the set up is correct or not. Never make some adjustments of the set up just because of one single arrow. Or change one thing at a time or you won't be able to know what was the reason for the change in the arrow flight.

Nocking Point

The nocking point helps to assure a constant arrow flight and is of greatest importance that it's set up correctly. For a good tuning an arrow flight a correct nocking point is absolute importance. There are several factors that influence the nocking point (tiller, grip of the string, release) but it's a good starting point to set it temporarily at one shaft diameter above a 90 degrees angle. With a checker this point can be found very easy.



Picture 59: Finding the place for the nocking point with a check

If you use a clamp on nocking point, don't clamp it ght, because we might have to move it up or down to find the best spo
For the fine tuning we go outside and shoot arrows the nocking point is to high or to low, the arrow will wiggle up nd d It's possible that the back of the arrow moves very clear up and dow few t s, or that the arrow only lift it's back slightly when leaving the

Now we move the nocking point for 2 mi ters and observe how it affects the arrow flight. If it's getting move up the nocking point for another 2 millimeters and check again. If t ro ight is getting worse, we have to go back and move the nocki t d the string for 2 millimeters and check again. Repeat this pr ure til the arrow leaves the bow straight and don't move up or down at all.

Arrow Tuning

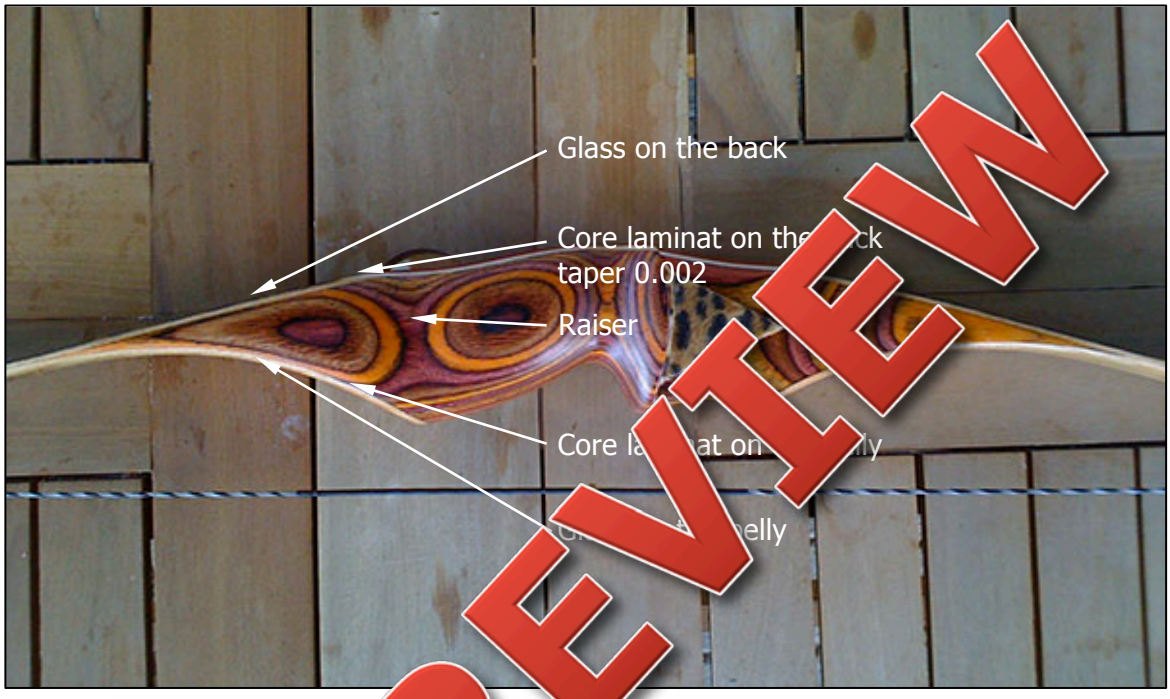
For this we put a black, vertical line on the center of our target and try to hit it from distance of approx. 15 to 20 feet. We watch straight on this black line and check if we can hit it or not. For this task we don't adjust or watch over the arrow.

Bow Building One Piece Recurve

Building a one piece recurve is basicly the same thing as building a deflex/reflex-longbow. But there are a few particularities that I will explain here.

Composition of the Bow

Since the stack of a recurve has to be way thinner than the one of a deflex/ reflex-longbow we use only 2 core lams for a recurve instead of the 4 that we used for the deflex/reflex-longbow (2 veneers + 2core laminates). The glass to wood ratio of the stack should not exceed 40%, otherwise the bow might get a bit limp. Therefore we use 0.030 glass lams.



Picture 67: Composition recurve

Since the limbs thinner and have recurved ends, we don't need as much taper for this Only the lam on the back of the bow has a taper of 0.002. By doing this make the draw smoother and at the same time we reduce the mass in the tips.

To get a draw weight of 50 - 55@28 for a bow with this form we need the following stack: