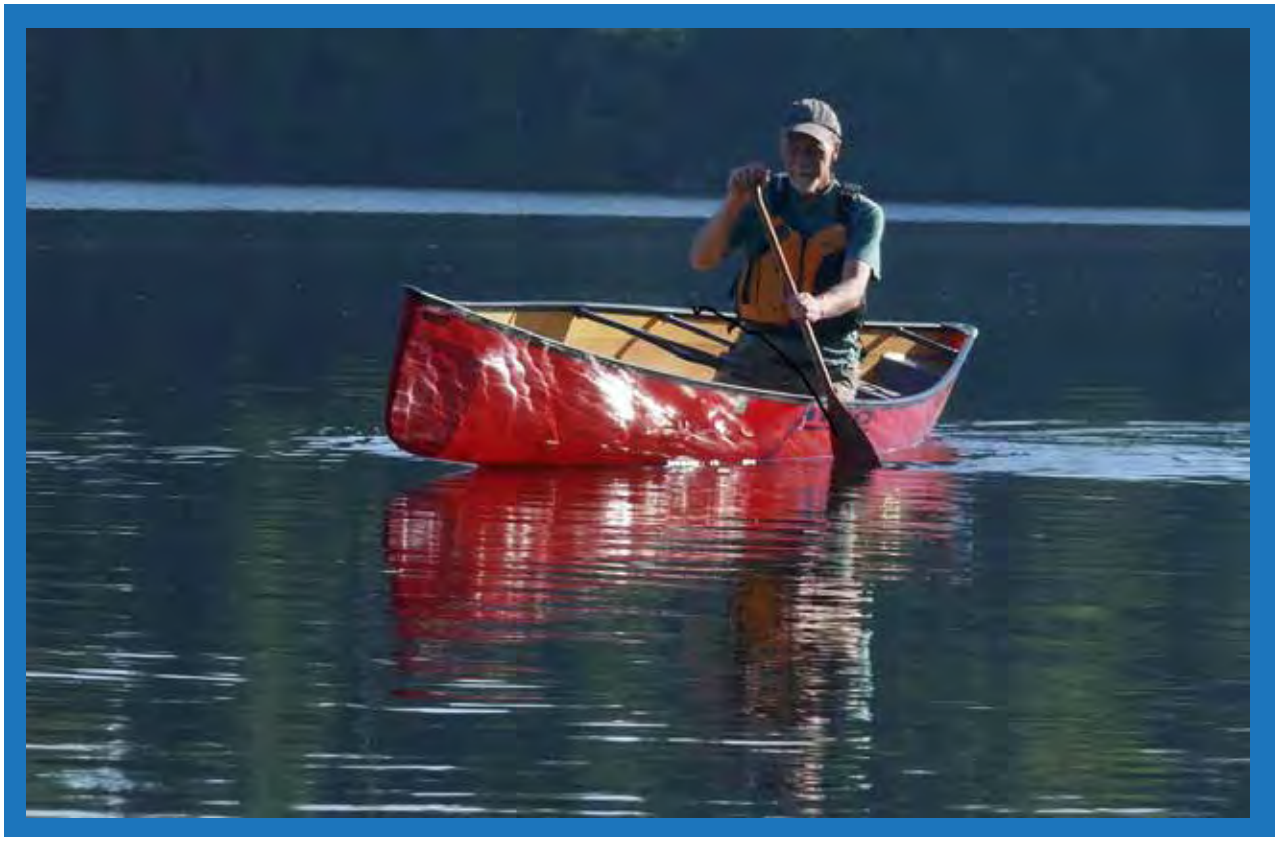
The Essential

Paddling Guide



Canoe designs, construction,
characteristics, paddles, and more

Rolf Kraiker

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Design Considerations

The canoe on the left has a recurved stem profile. When loaded for a typical canoe trip the underwater section ends about where the curve comes back providing maximum turning while reducing affect of wind above water.

The canoe on the right has a flared stem which greatly improves bouyancy in rough water but is harder to control in wind.

Canoes with plumb stem bands don't change as the canoe rides higher or lower in the water and they have a uniform response to any effect the wind might have.

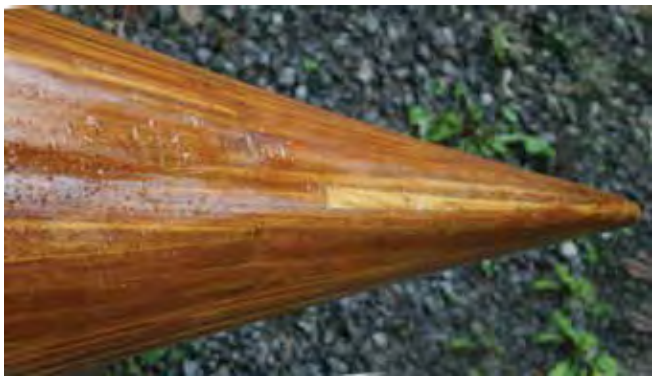
Side Profile - Flared/Tumblehome/Plumb

The canoe on the left has flared sides. That requires a greater reach for the paddler to connect with the water making it a bit harder but it has the benefit of becoming more stable as the canoe tips making it more suitable for rough water, if this canoe tips it will be gradual allowing an experienced paddler enough time to correct.

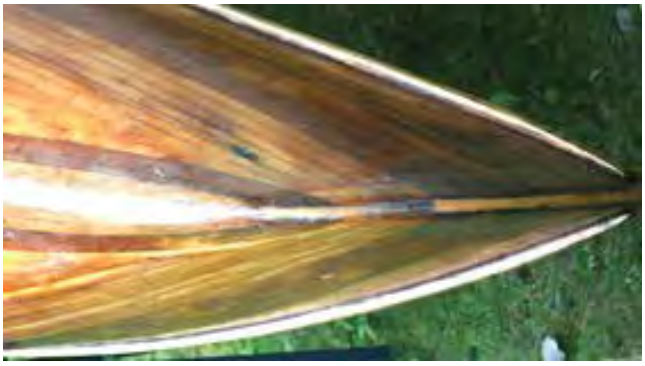
The canoe on the right has Tumblhome sides that are narrower at the gunnel than at the water line. That puts the sides of the canoe closer to the paddler making it more comfortable but there is no improvement in stability as the canoe leans. If this canoe tips it will happen quickly with little warning.

Plumb sides have a constant feel of stability until they reach the tipping point.

Entry line - Full or Sharp



The canoe on the top has very sharp entry lines. This will improve directional control and require less steering effort. The sharp entry line will also contribute to improved speed making it easy to paddle. However sharp entry lines will tend to slice through waves which can slow a canoe down in rough water. As well, the deeper canoes like this ride in the water, the harder it will be to turn.



The canoe on the bottom has very full, blunt entry lines that provide greater bouyancy in rough water and the design will easily ride up waves instead of plowing through them. It makes for a very dry canoe in rough water but the compromise is that the canoe wants to turn easily and requires a lot of attention by the paddler in order to keep it under control.

Design Considerations

Do you want a canoe that turns easily, or...
Do you want a canoe that doesn't take a lot of effort to go in a straight line?

The entry line of the canoe on the left improves tracking but doesn't turn as easily.

The entry line of the canoe on the right will be very easy to turn but will be hard to keep going in a straight line.

There's isn't one canoe that does everything well. Improving one aspect of handling or performance will have a detrimental effect on another aspect.

Choosing a canoe that's right for you means knowing which elements of handling and performance are most important to matching your needs and then understanding how the various other aspects of a canoe's design you can compromise on to best match what you intend to use the canoe for.

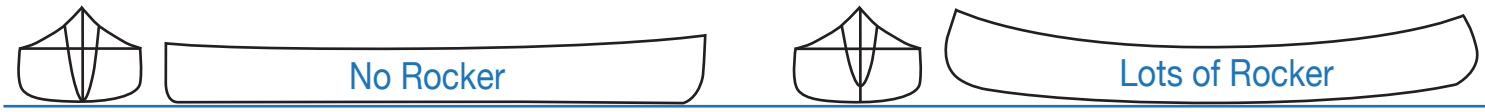
Matching your skill level with the performance of the canoe is a good place to start. A canoe that turns easily is harder to keep going in a straight line. A canoe that doesn't turn well requires little effort to steer on long stretches of flat water but makes it much harder to negotiate winding creeks.

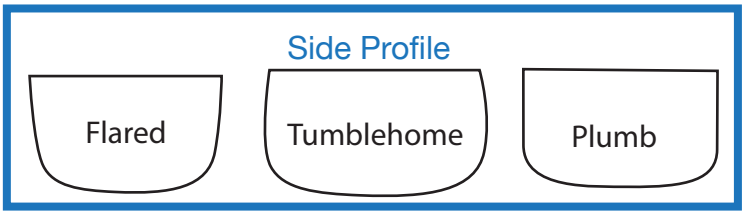
Sharp entry lines will slice through waves but blunt entry lines will ride up over waves make for a much drier canoe because there's less chance water will splash in. The amount of flare in the stems and in the side profile bow and stern will also affect how dry or wet a canoe will be in waves.

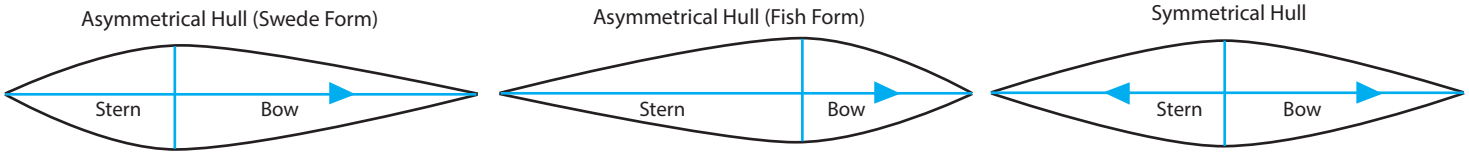
Rocker affects how a canoe turns. Asymmetrical means there's usually more at the bow than the stern. Symmetrical is uniform throughout while differential means rocker doesn't happen till the ends of the canoe. Hog Back is the opposite of rocker.

A flat bottom canoe will feel much more stable to enter than a canoe with a round bottom but it will be slower to paddle. Canoes with a a shallow arch bottom are a compromise that provide more stability than the round bottom but not as much as the flat bottom and will be faster than the flat bottom but not as fast as the round bottom.

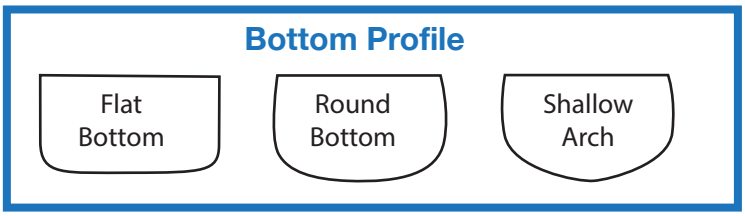
The diagrams bellow illustrate what is meant by the terms most often used to describe design elements.





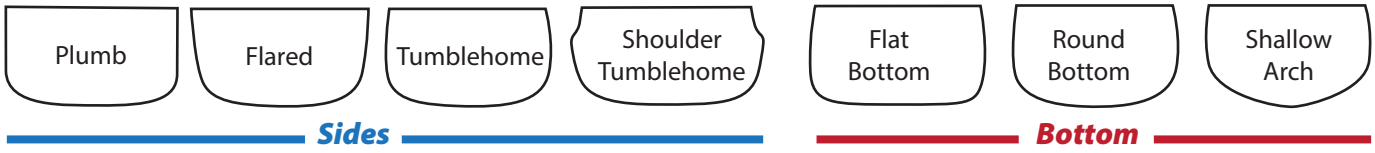


Rocker is what's below the water line shown as the blue areas in the diagrams below



Design Considerations

Factors affecting stability and the difference between initial and secondary stability



Stabilty overview

Initial stability refers to what it feels like when you get into a canoe. If the canoe does not feel tippy it has good initial stability. Secondary stability comes into play as the canoe is tipped towards the water. A canoe with good secondary stability will tend to right itself the more it tips but it takes time to become comfortable with the sensation and trust the canoe won't tip suddenly.

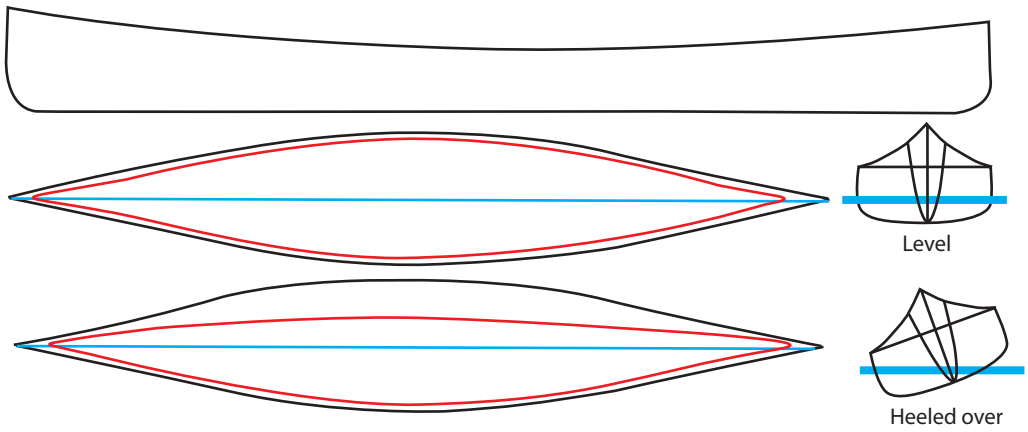
A canoe with flared sides will have the greatest secondary stability. A canoe with plumb sides will feel more stable than a canoe with tumblehome as they are leaned over.

A flat bottom bottom will feel very stable when you get into it but if it does tip that will happen quickly with little warning. A round bottom will feel uniformly tippy while a shallow arch bottom is the compromise between the two extremes.

Chine is the term that describes the transition between the side of the canoe and the bottom. A hard chine is when the transition happens abruptly and a soft chine is when the transition happens gradually.

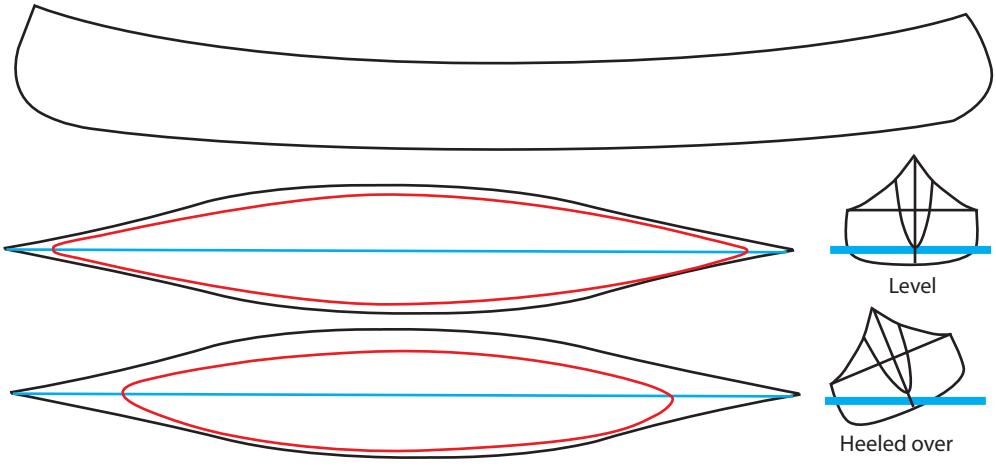
Generally speaking, the shallow arch design is more desirable for an experienced paddler, round bottoms are best suited to paddlers looking for speed and flat bottoms are more suitable to novice paddlers. There are some exceptions. For example - an experiened white water paddler can use a hull with a flat bottom and hard chines to "carve" the current in a river to advantage while the current will tend to grab the canoe suddenly and tip an inexperienced paddler.

Why different canoes turn differently when heeled over



No rocker

When heeled over (leaned), a canoe with little rocker will have significant curvature on the side of the canoe that's leaned into the water but very little curvature along the keel line at the bottom. That means the canoe will tend to naturally turn away from the side that's being leaned into the water.



Lots of rocker

When heeled over (leaned), a canoe lots of rocker will have curvature on both sides of the canoe. When heeled, the ends of the canoe will rise higher out of the water shortening the waterline making it easier to turn. Some canoes with a lot of rocker will tend to turn towards - not away from the side that's heeled towards the water.

Design Considerations

The key to using this chart is that you must determine the one performance criteria that's most important to you and look for a canoe that has the design features to provide the handling characteristics you want most. Then consider the additional types of performance you want and look for design features you can compromise on to find a canoe that does fairly well in those aspects and finally consider performance criteria that aren't important and eliminate canoe designs that go counter to the areas of performance you need.

No single canoe will do everything well. If one aspect of performance is more important to you than other areas you will have to find compromises. If you want a canoe that does most things well, it won't excel at any of those so you need to pick a canoe that has good, not great performance in all the types of handling characteristics you

Canoe Shape	**Performance**						
	Turns	Tracks	Stability	Speed	Wind	Waves	Water
Side Profile							
Flared	*	*	*	*	Good	Best	Rough
Tumblehome	*	*	*	*	Good	Fair	Average
Plumb	*	*	*	*	Good	Good	Calm
Bottom Profile							
Flat	Good	Fair	Stable	Least	Fair	Poor	Calm
Round	Fair	Good	Tippy	Best	Good	Fair	Average
Shallow Arch	Fair	Better	Fair	Fair	Good	Best	Average
Stem Profile (Bow and Stern shape)							
Recurved	Good	Good	*	*	Good	Good	Average
Flared	Best	Least	*	*	Least	Best	Rough
Plumb	Least	Best	*	*	Best	Fair	Calm
Rocker							
None	Least	Best	*	Best	Good	Good	Calm
Lots	Best	Least	*	Least	Fair	Good	Rough
Moderate	Fair	Fair	*	Fair	Good	Good	Average
Asymmetrical	Fair	Better	*	Better	Good	Good	Average
Hull shape							
Asymmetrical (Swede Form)	Fair	Best	*	Best	Good	Fair	Calm
Asymmetrical (Fish Form)	Fair	Fair	*	Fair	Fair	Good	Average
Symmetrical	Good	Fair	*	Fair	Fair	Best	Average

* NOTE – these elements have slight or no affect on handling.

Choosing a canoe is a lot like choosing a vehicle. You need to think about what you want to use the canoe to accomplish and then match the performance characteristics to find one that suits your needs. If you've got a family to cart around you might choose a minivan as your vehicle and a comparable canoe would have lots of room, be stable and easy to steer. If you want to spend time in white water you'd want sports car like performance, the canoe would be very easy to turn, handle waves with ease but you'd have to be a good “driver” because it won't go in a straight line without constant attention. If you plan on doing long trips, you might want to consider a “pick up” style canoe. That means you want to make sure it can handle heavy loads, there will have to be compromise between ability to turn without putting too much effort into steering. It should handle waves well, but it should also handle well in wind. If you have an interest in doing all of those things... you'll want to consider an average sedan style vehicle. That kind of canoe won't do any one thing particularly well but it will do all of those things reasonably well.

If you do mostly river travel where you will have to deal with waves caused by current, flared sides and a flared stem will serve you well. If you do a lot of lake travel, it will be wind that causes waves and the flared stem will handle the waves fine but the wind will catch the stems and make it harder to control so you need to compromise on the shape of the stem.

Things to watch for when examining the quality of wood when choosing a solid wood paddle

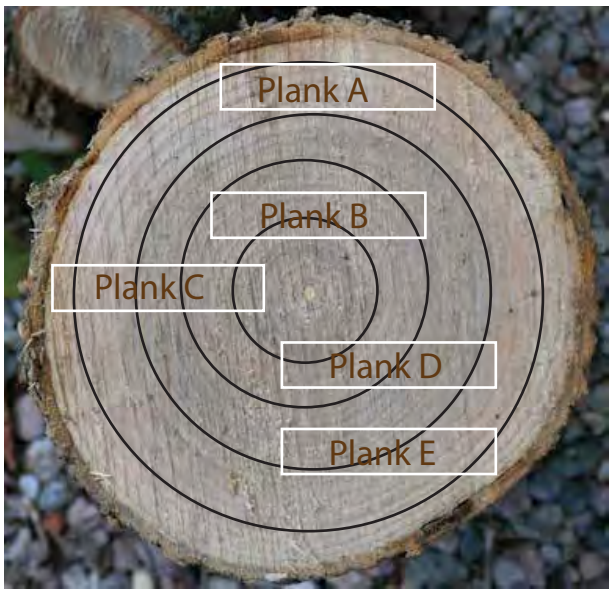


FIG. 1 - Plank A

FIG. 2 - Plank D

FIG. 3 - Plank E

The species of tree and where it grows has an impact on the wood used in a solid wood paddle. FIG. 1 is Black Cherry made from Plank A from a tree that grew in circumstances that kept growth rights very small. FIG. 2 is cut from a different section of a log from a tree that grew in circumstances that made the growth rings farther apart. FIG. 3 is White Ash cut from a section of log towards the outside curve off center. The grain structure found in Plank A and Plank C will have the optimum grain structure for a solid wood paddle. Maple is a firm, heavy wood with little flex. Ash is light and flexible. Oak has good flex but can be brittle. Cherry has a unique grain structure that is ideal for making solid wood paddle.

Direction of Grain

The log on the left is perfectly straight. Trees like this can usually be found in mature forests. Saplings begin under a full canopy and invest their energy into reaching for the sunlight. That produces a trunk that is straight with few branches along the length of the trunk until the very top.

The log on the right has a slight curve which will show up in the grain structure of a paddle made from planks cut from this tree. This curvature will have minimal effect when it happens in the blade but does have implications if it occurs in the shaft.

The close up photos of a paddle shaft illustrate how the grain will show up in the shaft when the grain doesn't run in a straight line because the tree had a slight curve in the trunk.

The growth rings in White Ash are more porous which can cause some lifting in sections where the rings are more exposed like the close up in the far right photo.

Density of Grain

These two Black Cherry paddles were made from planks cut from different sections from different trees- blade detail on the left and shaft detail on the right.

The top paddle was made from one of the ideal planks cut from a tree that probably grew in lots of shade. The growth rings are very tight which produces a grain structure that's very dense. That means the paddle is less prone to showing dings if the paddle is used against the gunnel when paddling and it will be less prone to warping.

The bottom paddle was made from a tree that grew in a situation where circumstances resulted in growth rings that are much farther apart and the plank came from a section of the log that produced grain tighter on one side of the blade than the other.

Black Cherry is an excellent choice for a solid wood paddle and both of the ones shown here will be good performers but the top one is a better choice than the bottom one.

Wood is quirky, its hard to predict how well any given plank will transform into a good paddle.

Paddle Grips

Paddle Tips

Paddles come in a variety of shapes and sizes. The length and width of the blade determine what kind of conditions are best matched to performance, shallow rivers, deep water, touring, white water of sprint speed are factors to consider.

The length of the shaft changes depending on the height of the paddler, how they paddle and the kind of canoe they paddle in.

Paddle grips vary quite a bit. The photo here shows two different styles, a stylized pear grip and a more traditional pear grip. The H&H grip in the middle is by far the most comfortable I've used.

Paddle tips are often subjected to abuse when the paddle is used to push off from shore when the canoe is grounded. Many manufacturers reinforce their tips with a resin coating like this H&H Thompson model.

My favourite all round canoe - the Old Town Appalachian

Flared
Entry
Bow & Stern

I've owned and paddled a lot of canoes over the last 50 odd years of canoeing but if I had to get rid of all but one... this is the one I'd keep. The symmetrical rocker means its very predictable paddled tandem but it performs exactly the same if turned around to paddle it solo. The stems are flared to bounce over waves, but not so much that they are strongly affected by wind. It has tumble-home in the middle third to make it easier for a solo paddler to reach the water but the outer thirds are flared to shed water. The combination of flare and tumblehome balance each other out so it is very predictable when leaned. The hull has a shallow arch and the entry is slightly concave to aid in tracking but not enough to make it hard to turn. This canoe doesn't excel at anything but it does everything well. Unfortunately, it is not in production any more but the Esquif Canyon and the H2O Alpha would be comparable.

Mid section

Bow and Stern

Shallow Arch
Bottom

Tumblehome

Flared

Compound Entry Lines

Construction Materials

Canoes can be made from a variety of materials that fall into four basic categories, budget, durability, light weight or beauty.

Budget - A fiberglass canoe that has three keels on the bottom like the one in the top left photo are the cheapest to manufacture. The least expensive ones are produced by spraying chopped fiberglass strands combined with resin into a mold. Slight better ones use a coase material called woven roving like the sample photo. Better ones will use fiberglass cloth which is a tighter weave, is stronger and weighs less. The three keels are there to reinforce the hull, not to improve handling.

Durable - Plastic and aluminum are the most durable canoes. Aluminum has zero maintenance but they are noisy, generally do not paddle well and are cold when temperatures are cold. There are several different ways to make plastic canoes. The best ones were made from Roylex like the two in the upper right photo. Sadly that material is no longer available but there are some materials that come close. The better plastic canoes are made with laminated material. There are some plastic canoes made from a single layer of plastic and they are easy to spot as they usually have an aluminum pole to reinforce the keel as the material is too flimsy to maintain the shape.

Beauty - It is hard to beat the beauty of a traditional wooden canoe. The one in the bottom photo is made of cedar planks reinforced by cedar ribs that are held in place with copper tacks and the canoe is covered in canvas. They are very durable, easy to repair, a joy to paddle but when it comes time to portage the weight can be discouraging.

Beauty

Beauty

There are a lot of beautiful canoes made from modern composite materials like the one in the top photo. These can be a joy to paddle, are light weight and quite durable but there is a lot of variation in hull design and quality of construction.

There are two significant methods in manufacture, the one in the photo has a colour impregnated material covered in epoxy. The other type of construction will have an outer layer of gelcoat to produce the colour.

Most manufactures apply a UV protection coat but that will deteriorate over time if the canoe is stored in full sun. Gelcoat provides better protection but adds approximately 8 pounds to the finished canoe.

This type of construction offers a wide variety of options that lets a paddler choose the best compromise between weight and durability.

The two canoes in the lower photo represent the easiest way to make your own canoe. They start as station forms that make the shape of the canoe placed at 12 inches apart on a platform called a strong back. Cedar strips about 3/4 of an inch wide and 1/4 of an inch thick are placed lengthwise on the hull and glued together. Once the glue has dried, the wood is sanded and then covered with fiberglass cloth. Epoxy resin is applied to hold things together and that turns the white fiberglass cloth transparent. Once the epoxy has hardened, the canoe is taken off the forms and the inside is sanded and another layer of fiberglass cloth and resin is applied.

After the expoxy has fully cured and hardened, the trim like gunnels, thwarts and seats are added.

While these look like wooden canoes, the wood is just a core between two layers of fiberglass which is the main structural component. These Stripper canoes are quite durable and can be quite a bit lighter than a wood and canvas canoe of the same type.