Viking Ship Construction

The Roar Ege strutting her stuff for the camera.

Who were these fierce warriors who came from the countries that we call Denmark, Norway and Sweden today?

Well, they were not the only sea pirates to use ships of the kind you can see on the left - but they are the ones that we know best. The Viking Age for England started in 793AD with the raid on the Monastery at Lindisfarne Island high up on the Northeast coast of Britain and more or less came to an end in 1066AD at the battle of Stamford Bridge near York.

It must have been an apprehensive time through which to live, but although it lasted for 273 years, there were never more than a few thousand raiders involved at any time. Many English people must have lived out their lives without ever seeing a Dane - as the Anglo-Saxon Chronicle invariably calls these fearsome foes.

Without their ships, and the ability to pick and choose where to attack, they would have only been a footnote on history's page, so let's look at what made these craft so special, and the Vikings so feared.

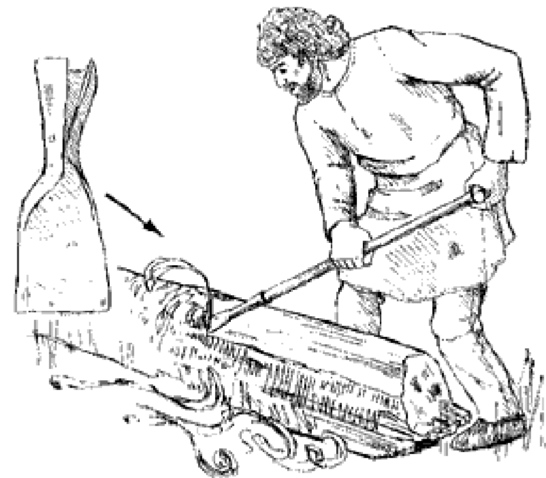
All ships at this time were made principally of wood. For a long time, it was the considered opinion that only Oak was used, but as more shipwrecks from the Viking period have been discovered, we've learned that ships were made out of Ash, Elm, Pine and Larch and several other woods too. As a rule, only the greatest warships were always made from Oak, not only because of the great strength of the timber, but also because the tree was sacred to their warrior God Oðin.

People who make ships and boats are called Shipwrights and it's their expert carpentry that could not only turn trees into ocean-crossing vessels, but understood the different needs of - say - a cargo ship and a fishing trawler. As there were no DIY department stores down the road then, so it was a matter of going out into the forest and selecting the trees.

It was a very skilled job, as the shipwright would decide which trees were best for the various complicated tasks the wood had to do when it was cut to shape and fitted into a ship.

Different parts of the ship came from different parts of the tree and you can see some elements shown in white in the graphics to the right. They took advantage of naturally grown 'joints' where branches grew from the main trunk. These are stronger than man-made woodworking joints, and avoided the need for glue or clenched nails in the construction.

The shipwrights also sometimes re-cycled planks from 'decommissioned' ships, filling in gaps and joints with carefully-made patches and re-fitting them into a new ship or using them to repair old ones. There were always a number of ships that required some attention and modifications, that kept the shipwrights busy in between new commissions. Only the king and some of the more powerful chieftains would commission new large war or trading vessels, paid for by either taxes or by obligations because of national security. The smaller fishing boats, coastal traders etc, were within the means of the lower social classes, however, we do not know whether there was a system of credit to cover the cost of construction which was then repaid in some shape or form. Log boats, although a very archaic style of boat, were also quite common, as they are easy to make, and cheap. If you were only needed to cross small rivers, or lakes, or even move a few livestock, then a log boat would suffice. The log boat was such a durable design, that it's construction lasted until the early eighteenth century in England, and was still being made in places such as Poland in the 1930's.



A felled trunk is peeled of it's bark with a Bark Spade.

But before anything was constructed, the tree had to be cut down. This would be done with axes and wedges. The trunk was notched in the direction you wanted it to fall. Then a deep cut was made on the opposite side and wedges driven in to help push the tree over. The limbs and branches that met the trunk were cut free before the tree was felled, to prevent them from being shattered by the weight of the tree as it fell. This of course could only be done with the smaller components involving the outer limbs.

There has been some equipment that has been identified as tree climbing tackle, so that the worker could ascend the tree in a seat/sling. Then he might support a particular branch with lines to assistants on the ground. The tree branch would then be cut free, and lowered carefully to the ground. Although there were saws around to help with this kind of work, they were not common, as the blades were particularly difficult to forge. In the Domesday book, compiled in 1086AD, there is mention of only 13 saws in the Kingdom in England, leading us to think that they were probably pit saws that could be used to separate a plank from a log. The smaller bow saw, with a consequently smaller blade, was a common feature of carpenters tool sets, but was only really used for cross cutting timber, and only small pieces at that.

Logs are split rather than cut, as the split always follows the grain and doesn't cut across it.

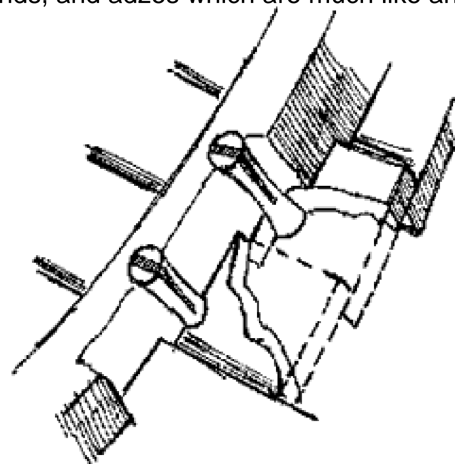
Once the tree was down, the bits that were not going to be used would be trimmed off. Almost nothing of the tree would be wasted. The bark went to tan hides and skins; the bast fibres just beneath the bark were used to make rope; the twigs were chopped up and added to sawdust and chippings and used to smoke fish, meat and cheese; and the smaller off cuts saved to make charcoal. The main part of the trunk would then be split into wedge shape sections like slices of cake (as seen in cross-section) and these slices were then trimmed into planks. This was done by shaving off part of one of the sides, and then shaving off some of the thinnest edge to make a flat plank.

Splitting a log involves starting a split with an axe, and whilst the axe is still lodged in the timber, an oak wedge is then hammered in to the split next to the axehead. The axe can then be hammered in further with a wooden mallet. This will make the split travel down the length of the log. Another wedge is added, and the first is banged further in. The axe can then be removed an sometimes hammered in further along the split. So the process goes on, with most of the work being done by the wedges saving the precious axehead. The split can be controlled to some extent, but a good carpenter would select a tree that hadn't twisted as it had grown over the years. A prevailing wind is the culprit here, forcing over time, the tree to withstand the forces of the wind direction and grow stouter on one side.

Trees grown in woods and forests do not suffer from this anywhere nearly as badly as lone trees that don't have any neighbours to shelter behind. By splitting the timber in this way, the carpenter is working with the wood so as to get the

greatest strength out of it. A saw would just cut through anything in it's path, ignoring the grain in the timber. A large log may not be turned into just planks, as he might leave half of the tree unsplit for bigger parts of the ship like the Keel, Ribs or the Mast Step. This was sometimes called by the Vikings the Keelson or "The Old Woman". It is a key part, as the mast sits inside the socket' cut in it and grooves cut on it's underside allow it to sit over the Ribs of the ship.

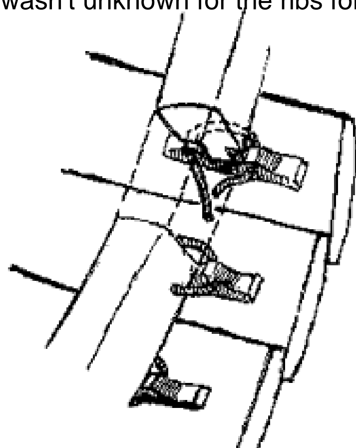
Almost all the work on the ship would have been done with axes of various kinds, and adzes which are much like an axe, but with the blade turned through 90 degrees. Hammers, wedges, chisels, drawknives and planes with saws only occasionally being used.



Trenails used to anchor ribs and strakes together.

Sometimes, parts would be held together with Trenails, wooden pins that were split and wedged to hold them in place. As iron was as expensive in those days as silver is to us today, Trenails, which are 'wooden rivets' are employed in many areas of the hull. They are simply wooden dowels that are driven into previously bored holes through the component pieces. Then at either end of the dowel, a small split is started, into which a small wedge is also driven. This locks the trenail in place, neither being able to work it's way forward or back. There is some research that has shown that if the parts of the 'nail' are boiled in Linseed oil prior to being assembled, after which they will remain locked together almost indefinitely. The Slavic tradition of Viking ship building such as from Northern Poland owes a lot to the trenail, and less to the use of iron. Whereas in the western half of the Viking world, it is the other way round.

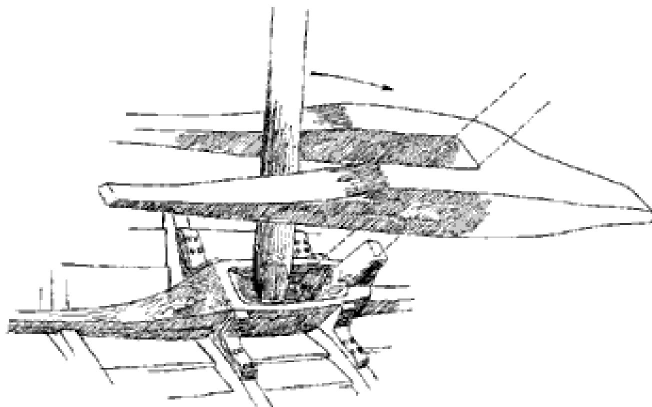
It wasn't unknown for the ribs for example to be lashed in place with bast fibre cords, that were soaked in pitch to preserve them. This may seem a balmy way to build a ship, but it has been used in vessels for thousands of years prior to the Vikings, and served them equally well. Again this will enable the hull to twist in the water, and absorb some of the wave energy without over stressing the hull. The cord is sewn through the ribs and the strakes, with special cleats left on the planks for the job. This was a very time consuming task to make, but it did save on the iron nails.



An example of strakes lashed with bast fibre ropes to the ribs.

Below, you can see where the Keelson (or mast step) fits into the Hull. The mast is slotted into place, sitting against the Mast Partner or "The Whale" at deck height. This timber seems to have only been used on decked ships, spreading the thrust from the Mast through the rowers Thwarts (or the seats that straddle the ship) and Ribs to the Hull. This was the technique that predominates in the older style of Viking ship, but evolved into a less cumbersome method where the Mast Partner is done away with, and replaced with the expedient of supporting the Mast at the same point with a beam that ran crosswise across the ship, anchored to the upper Strakes at roughly the mid point of the ship. The rest of the support for the Mast came from the lines or Stays that ran from its apex to various anchor points in the ship.

Whatever the shipbuilder decided to make the hull from, the keel and its end post extensions were invariably made of oak. On most ships, the Bowpost and Sternpost were specially shaped to accept the ends of the Strakes or planks that formed the hull of the ship. This was because the shaping of the plank ends to fit an unshaped end post was very expensive in timber - and you could get a better seal with the larger sealing area provided by a shaped post. The inward tapering and narrowing of the ends of the strakes created the upward curving nature of the Viking hulls. So that the style of building was essentially the cause of the Viking ship's outline. Had they followed other techniques in building, the Viking ship as we now picture it would not have happened. An interesting diversion from the Viking style of ship construction can be seen at the museum of Utrecht. This type of hull is called a Hulk construction, giving the ship a 'banana' shaped hull which has low prows. It can also be seen stamped as a symbol onto coins from the area, which first alerted historians as to uniqueness of this style of building.



The older style ships used very heavy timbers as here with the Keelson and Mast Fish to anchor the mast in place.

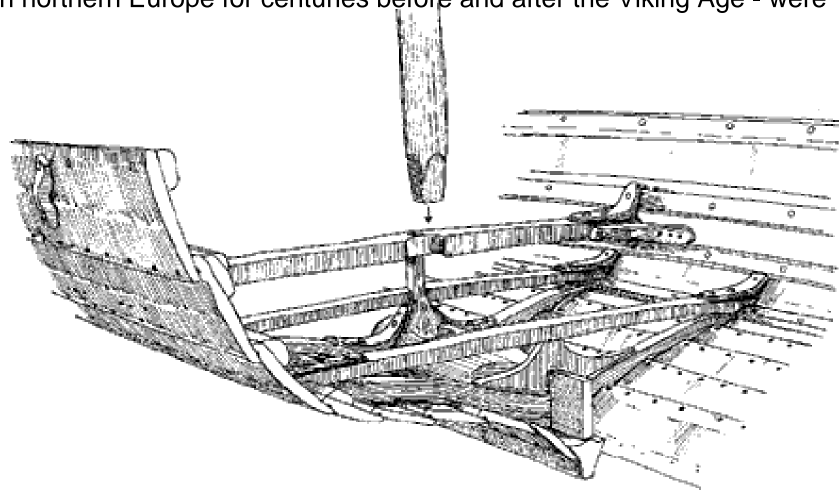
The Bow and Sternposts were sometimes stored over winter in bogs, as a find from Scotland attests to. The archaeologists were stumped to find any other answer than the work had to come to a halt over the winter, and so the posts were stored in the water to prevent them from drying out prior to continued work in the spring, as all the timber on a Viking ship is worked essentially 'green', or straight off the tree.

The Sternpost was a very large piece of wood and - as in later wooden vessels too - governed the final height of the finished ship's bow and stern. This in turn dictated the length of the ship, so trees big enough to make these special posts would have been very valuable. By the end of the Viking Age it was becoming more and more problematic to find trees in Scandinavia big enough to provide really heavy timbers. This in turn forced them to seek far and wide for these timbers, and start considering different building practices.

Once the main timbers had been chosen and carved from the solid wood, the construction of the Hull or body of the ship could begin. The Keel the lowest and most central timber, was the primary and most important timber in the ship. It ran from one end to the other as a single piece of wood, with the Bowpost and Sternpost being attached at either end. It would be constructed lying the correct way up on in situ near the riverside. The posts and the keel would then be joined with iron roves to start the hull, with the three main sections being wedged securely upright with wooden props.

The first of the Strakes would then be shaped and clamped in place, holes drilled through both pieces of wood and iron nails driven in hold the Garboard Strake into place. This Garboard Strake is one of the trickiest components to fit, as it is in practice a flexible plank joined to a fairly inflexible keel. There is always the tendency for the ship to leak at this point. To counter this, animal hair rolled in hot Pitch (made by boiling birch roots to obtain the roasted sap) was trapped between the edges of the joint.

All Viking ships - and, come to that, all ships in northern Europe for centuries before and after the Viking Age - were made by this method of overlapping the edges of the Strakes and riveting the overlap section together. It's called Clinker building and makes hulls that are light and flexible, hulls that will flex and bend in the open sea without breaking or letting in too much water. In the image to the right, you can see the Shipwright clamping two Strakes together before roving together. The heads of the iron nails on the joints that he's finished are plainly visible. About 700 kilos of these iron nails were needed to make even a fifty-foot deep sea trader and you'll recall that in round about terms, iron was as expensive as silver is to us today.



In the later style ships, the reliance on huge timbers to support the mast was replaced by rigging and lateral struts.

Upon closer inspection you can see how all these bits of wood were held together sufficiently tightly to make the ships strong enough to cross the open ocean. After the long wedge of tree has been split off the log, it's smoothed with and axe called a Side Axe. It has a specially off centred broad blade and a bent handle so that your hands are clear of the work. It does the bulk of the work that you might use a plane for today. You can still see on the Bayeux Tapestry the Shipwrights using just such a tool. One was also found in London.

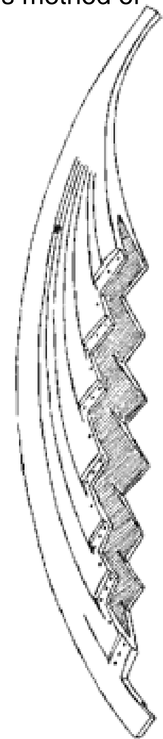
The plank was not merely flat in shape. It had a sloping top edge with a groove cut in the lower edge it for the Caulking of pitched animal hair. The top and bottom were not straight, but cut to follow the line of the hull in any particular place. Once the Strake had been shaped, then it was clamped into place on the hull, and then riveted home. Notice that the nail is being driven through a hole that's been drilled already through the strake. If you don't do this the wood will almost always split, if not when you are doing the riveting piece together, then later - perhaps miles from land……..

Another strake is wedged in place ready to by permanently roved onto the emerging ship.

After the nail has been driven through, then a special washer called a Rove is forced hard over it, actually recessing into the wood a little way. The end of the nail is trimmed to size and then beaten with a hammer to make it too big to go back through the hole and this riveted nail cannot move again without snapping off.

As each strake is added, and the ship begins to take shape, only then are some of the ribs anchored into place. This can be considered as building the boat back-to-front. More recent 'traditional' ship building methods require the shipwright to build the frames first on the keel, and then to add the strakes after. This method cannot be used on a Viking style hull, as the flexibility of the hull would be entirely compromised.

As far as we can tell, it was the Vikings that invented this method of building ships and boats and it certainly allows you to make open hulls of great flexibility. However, it is not easy to seal the deck to such a flexible hull and therefore it was never possible to build a ship like this which did not act as a huge water tank in the rain or in breaking seas. The necessity of such a design meant that they either sailed only on the finest days in light breezes, or the mariners a thousand years ago were very hardy. The Sagas attest to their courage at sea in all conditions, and it would be ridiculous to think that they could avoid all poor weather, all of which warrants our great respect. One area of investigation that has yet to be looked into in any detail are the clothes that they wore specifically for sailing in. Once wet, hypothermia will set in very quickly causing death quite quickly. They must have been aware of the circumstances, even if they did not understand the mechanics of such things. The author can bear witness as to how uncomfortable it can be once you are cold to the core and well off the shore in a stiffer wind than was expected. However, as yet we have yet to even build the vessel.



A completed oak Sternpost, cut with some very precise symmetry.

Usually, planks are too short for a complete strake, especially on a large vessel, so they are joined together with a Scarf Joint. The planks have to be drilled and riveted together side by side with a diagonal chamfer at their ends.

Aside from the hull, there is the steering oar. There were various shapes and it seems to have been a matter of personal taste as to which one you used. The use of the side-rudder was the one great flaw of Viking Age ship design and it imposes considerable restrictions and considerations on how the ships can be handled. The steering oar (or Rudder) fits over a solid rounded piece of wood attached to the hull, often referred to as the Tit, for no earthly reason than it just does. The blade pivots on the 'Tit'. The Rudder is roped through the hull and the 'Tit' with woven larch root cord, but they always give trouble and it is really hard to see how the Viking made them work as well as they apparently did. This cord of root fibre was then tightened up to draw the rudder tight into the hull.

The rudder is also secured with a heavy leather strap to stop it flapping about and a rope from the top of the shaft runs back past the Samson Post to the last rib to stop the water drag from pulling the rudder forward when the ship is running at speed. In addition to all these elements, the rudder also has a line running from it's lower tip to help raise the rudder when the ship is in shallow water, or about to beach. If this is missed, all of the mass of the ship will tear it free in a trice when it strikes anything immovable such as land. The ship can be easily steered with just the oars doing all the work when the sail is down.

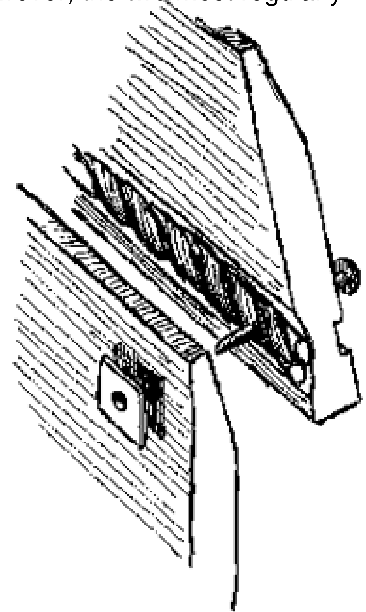
At different parts of the hull, the Wright would use different methods of holding the ribs of the ship in place. These were always fitted to these vessels after the hull was built and previous graphics show them tied in with larch roots and also they are trenailed into place with wooden plugs that have wedges driven into their ends. All of the ribs and other components known as Knees were cut from the curved parts of the trees where a branch met the trunk. From any one joint like this on the tree, at least two opposing knees can be split from the join. The grain isn't compromised, or cut through to making it weak, resulting a very strong part for the ship.

A Sideaxe in use. The strake is wedged upright so that the axe can be used in the vertical plane.

An uncomplicated example of this use of wood can be seen on smaller boats. The Cabes, known today as Rowlocks, were carved out of a single piece of wood at the point where a branch left the tree trunk. The fork of the branch acts as the backstop for the oar. The small hole through the Cabe takes a rope which loops around the oar keeping it up against the Cabe. Today, in wood, Shipwrights would use a pre bent and shaped laminate to achieve the same end. At the ends of some of the cross members that brace the ships hull laterally, three of these knees are used to help support the cross member and keep it in situ.

One of the most prominent parts of 'the' Viking ship would be it's figurehead. These are things of great romance and lore. Whilst it is fairly certain that they did indeed have figureheads on their ships, only a small elite would have carried them, and they would have all been warships of some description. The biggest shame is that only the Oseberg find from southern Norway, had any hint of decorated prows, and they were only carved spirals, rather than the fiercesome dragon heads that we come to expect. The Gokstad ship, Ladby ship and the Skuldelev ships have all survived without any sign of figureheads. This can be said of many other period ship finds. So where do we get this idea that they carried them? The simple answer are the Viking Sagas. They are rife with reference to them, however that is all we have.

On a personal note, I would rather that they did mount these things on their ships, however, the two most regularly quoted and depicted images of figureheads are either not from the Viking period, or are not figureheads. Dealing with the first; which is from the River Scheldt in Belgium, and can be found in the British Museum. It is arguable whether this is actually a figurehead of a ship. Exquisitely carved, it is securely dated to the 6th century AD. Not Viking at all, but possibly early Saxon or Frisian from the same date.



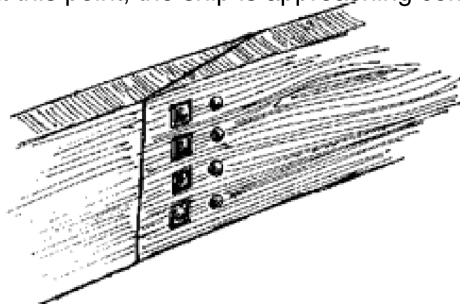
An example of roving. You can also make out the complex cross-section of the Strake.

The second piece I must mention is from the Oseberg find itself. It is often referred to as the piece carved by the 'Academician', because of the intricacy of the work and the restraint shown in not carving every mortal spot on the head. It is a delightful piece of Viking carving, but is too small to be a ships head, and was probably a seat finial or pillar. Which all leaves us in the land of speculation.

Until the day dawns when a ship is excavated with one of these figureheads in position, then the argument will still exist. I for one believe that the Sagas are correct in this particular detail, even if they weren't the norm. One reference states that ships were obliged to remove their 'heads' prior to entering a foreign port as a sign of their peaceful intentions.

There are from later period ships, a number of original examples of ships bronze weather vanes surviving. They seem to have replaced the Dragon Heads as a more practical option. A scratchwork graffiti bone rib from Bergen shows a number of ships at anchor, with all their prows up against the jetty. A number have weather vanes on their prows, giving us some great correlation between the finds and their use. The other possible site for the weather vane could have been the top of the mast, however the practicalities of having it at such a level would make this unlikely. There is also a word in the Norse language translated as flag (flaug), and this makes for a better wind indicator on top of the mast.

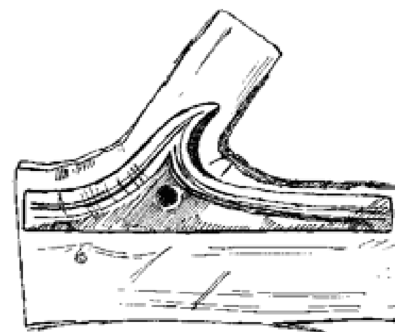
At this point, the ship is approaching completion and it's time to launch her. It is at this time that the 'luck' of the ship was established and much of the Viking's feeling for this important occasion has come down to us intact across the centuries.



A Scarf joint roved through from either side.

Getting the ship into the water has never been simply a matter of shoving her down the bank into the water. Before the Viking were Christian, the launching ceremony of a warship involved we are told a very bloodthirsty human sacrifice and even today we pour a blood substitute over the bow of a ship when she is launched. Champagne is a very new idea, as it used to be red wine ……….

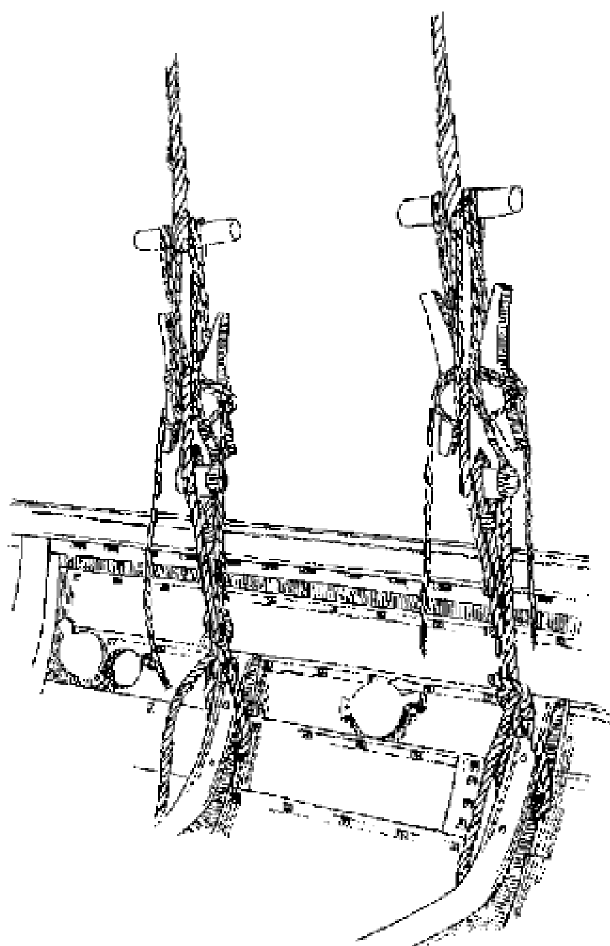
With the ship in the water, its time now to step the mast and attend to the Rigging. Most ship-rope in the Viking age was made of Hemp, but Linen, Horse hair from horse tails and greased Walrus hide, were also used and a right smelly product it must have been. To be honest, what we know of Viking ship rigging (the ropes and lines which are used to sail the ship) is mostly worked out on a "it was probably like this" basis as no-one bothered to write it down or draw it out for us at the time. Archaeologists have found lots of ships, but all the ropes have rotted away long, long ago, leaving only the wooden parts of the rigging system, and even then, it is not remotely complete. So various sources have been amalgamated to form whole sets of rigging for one ship. From what we have found and from experimenting to see how it might have worked, and from more recent Nordic fishing vessels that survived until the Second World War, this is how some of the rigging that supported one side of the mast to the hull probably looked.



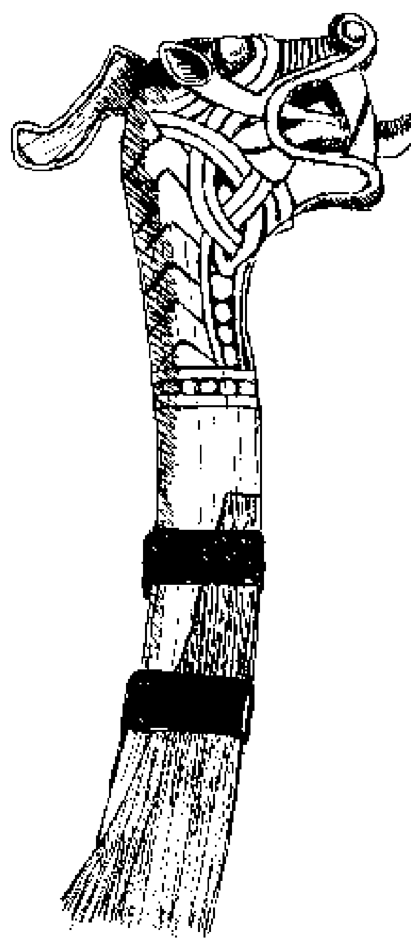
A finished Cabe overlaid on the other half of timber that it was carved from.

The pulley block had not been invented at this time and the Vikings used a curious devices called 'Virgins', 'Angels' or 'Maidens'. They are not a great idea as they often jamb or occasionally break and like the rudder, it is hard to understand how they worked as well as they apparently did. Only from use on voyages recreated today can we be sure that these rigging components do indeed work, even if they can be taxing. The Viking sailors put up with these idiosyncrasies because they knew no better and found life to be quite tolerable despite the absence of the stern rudder and pulley block.

Back a thousand years ago, the moment for goodbyes to be said has arrived with the tide and it's time to get your wargear out of winter store and set off in the early spring sunshine "to see the land of strangers, far away." If the gods were with you, you might even return with riches, or if not, a wound to heal...



An example of some of the rigging using 'Virgins' to help anchor the mast.



A ships dragon head, from the version carved for Hedeby museum.

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