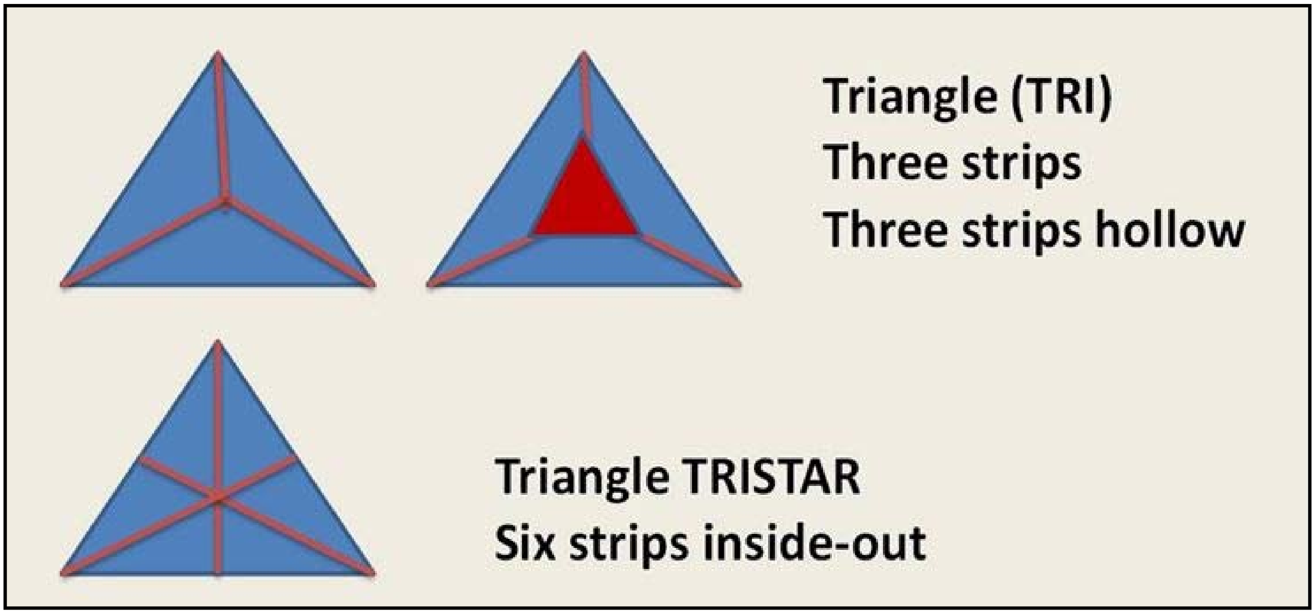
The Triangle Construction of Split Cane Rods

Text and photos by Tapani Salmi

.. and then something totally different…



SUMMARY

Triangle split cane rod **advantages:**

- Some physical properties (including Moment of Inertia (elasticity, stiffness)) are superior compared to six, five or four sided rods.
- It is possible to make long and light single and two hand rods with pleasant fishing properties.
- Same advantages as in extreme hollow-building are easily obtained using standard hand tools.
- Thick sections for two hand rods are obtained using normal cane thickness.

Disadvantages:

- The unusual/strange look!
- No tapers available.
- Problems with handle, ferrule, line guide geometry due to triangle shape.

Background

Some years ago I visited Egypt and saw some PAPYRUS REEDS growing in the river Nile and noticed that they are triangular in cross section. I realized that the triangle form has to give some advantages to the reed when standing in the constant river flow compared to the most common round shape. I have built split cane rods of several geometric compositions (hex, penta, quad) but because

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"nature is full of brilliant mathematicians," I decided to build a triangular cane rod. Thereafter, during several winters I have constructed triangular rods of different lengths. They are really promising in some properties, especially giving advantages as long rods. I will try to explain why and how to build such totally different fishing rods.

My wife and Nile river papyrus reeds - two biggest mysteries in the world?

Some Mathematics

Theoretically in engineering science the stiffness of an object (rod) is calculated using the formula of "Moment of Inertia" MOI or "Moment of Elasticity" MOE. The formulas for MOI and stiffness are different for hexagonal, pentagonal, quad and triangular constructions (see eg. en.wikipedia.org/wiki/List_of_area_moments_of_inertia#cite_note-tri-4 and www.efunda.com/math/areas/triangle.cfm).

The formulas are useful when comparing two or more bamboo fly rods. The formulas may be used if we have several rods with equal length and equal weight (their cross section area is equal at every point) but built as six strips (hexagonal, hex), five strips (penta) or four strips (quad) construction. The formulas are also the base of some taper-design software calculating stress curves of the rods. When casting the rods, we notice some differences in the action, in the stiffness of the rods, rods of same weight are faster or slower when they are built as hex, penta or quad. We try to forecast these properties using these mathematical formulas.

These mathematical formulas teach us that if we have the cross section area of 1.00 and the rod is hex (six strips) the MOI value is 0.080. The rod with equal weight built as quad (four strips) has MOI of 0.083 – thus it is about 3-4% "stiffer." The difference seems not to be very large but usually we are able to notice it when casting these rods. If the rods are hollow built the calculations get more complicated.

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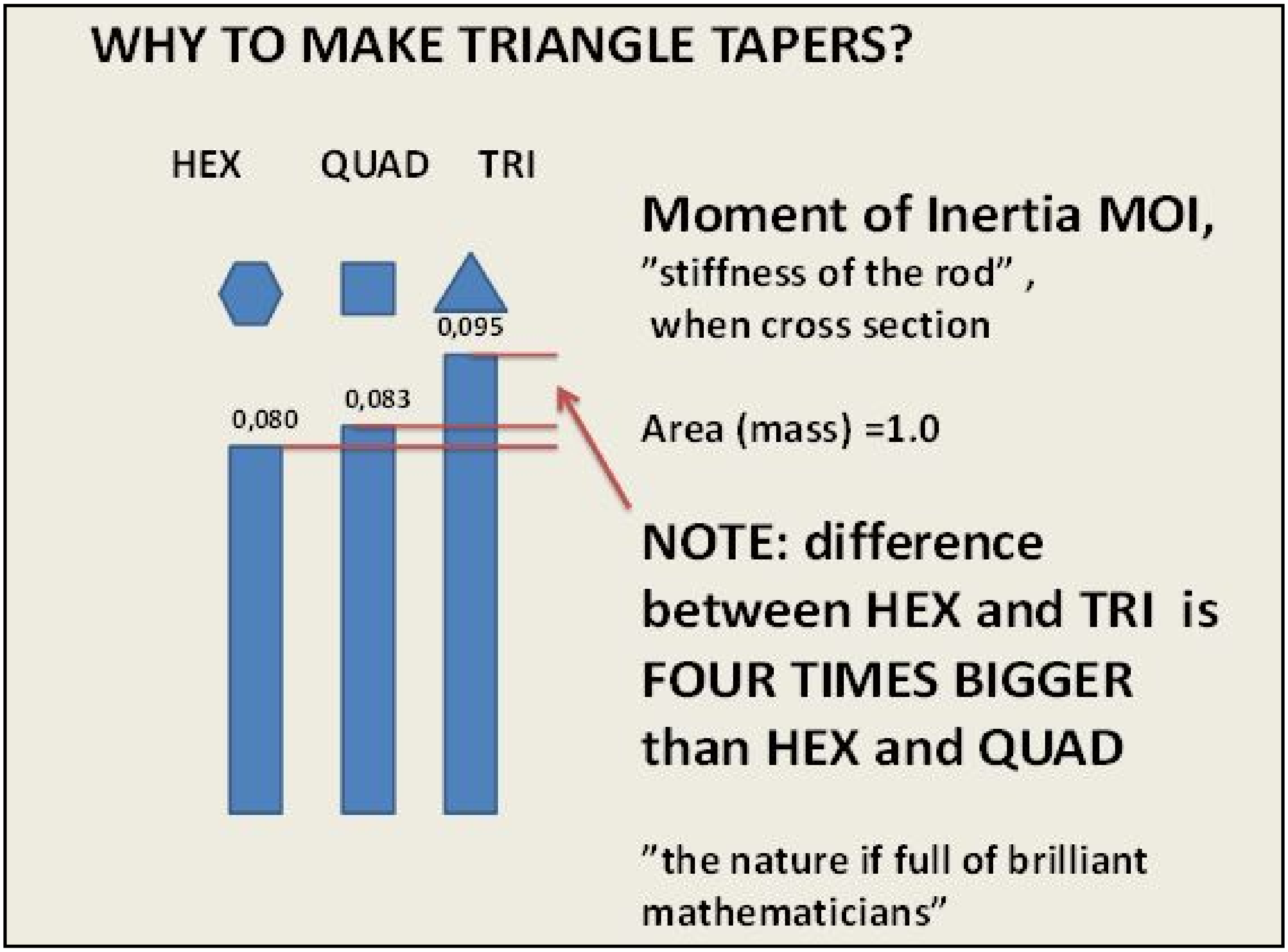
If we make an equal triangle cross section with the area of 1.0 the MOI is 0.095 which is 20% greater than hex rod. The difference in stiffness between the tri and the hex rod is thus **FIVE TIMES** the difference between quad and hex. If you are able to notice the difference between hex and quad you really notice the surprising difference at once when casting a triangular rod. The triangular rod is much, much stronger, stiffer and faster compared to hex or quad rod of equal weight.



Comparison of MOI (stiffness) of HEX, QUAD and TRI rods of same weight.

Practical Issues

In practice the higher stiffness and power is of great advantage when constructing long rods. Typically, traditional rods longer than 8 1/2', 9' and 10' seem to be either quite slow and/or quite heavy, especially compared to graphite rods. The long two-hand salmon rods are a very special problem. Bamboo is a good material to build a spey rod but the long traditional spey rod tapers result in very heavy rods. The wall thickness of heavy two-hand rods also has to be quite thick. It is not easy to find such a thick cane culms and this has resulted in different technically difficult solutions (hollow building, double strip building, etc). Triangle rods give nice advantages with the extra stiffness of the triangle construction shape. Combined with inside-out or hollow structure the triangle rod consists only of strong power fibers.

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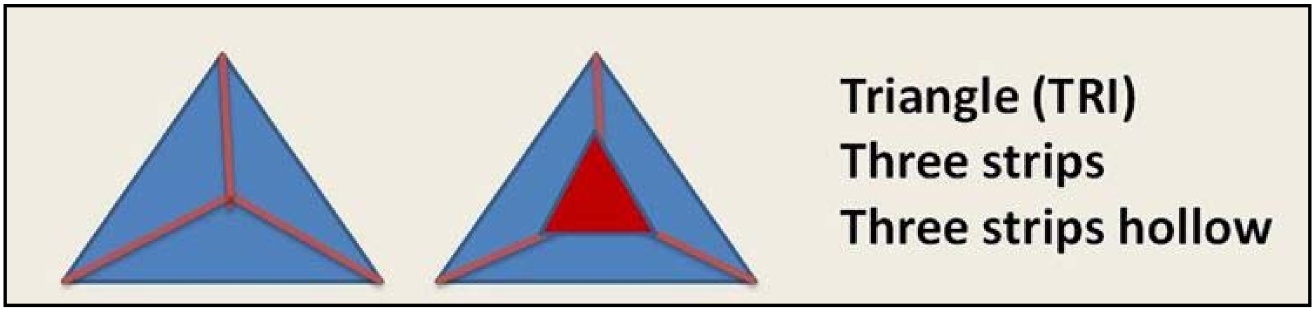
CONSTRUCTION I - Triangle Cane Rod with Three Strips



Schematic presentation of three strip triangle rod cross section.

I started the experiments by constructing a Triangle (Tri) rod with three strips. Such rods have to consist of very wide strips with corners of 30-120-30 degrees. These kinds of strips are not very easy to make using hand tools. I started the construction by making an Excel spreadsheet to convert the "hex tapers" into equal triangular area and equal mass to get the dimensions of the strips.

To get the 30-120-30 degree I first made 60-60-60 degree (Hex) strips with equal width as the final 30-120-30 strips. To get this kind of final rod taper dimensions the strips are converted by multiplying the dimensions by 2.45 (= sqrt(6)).

Thereafter you have to plane the top 60 degree corner into 120 degree corner. For that purpose I used first a simple hand mill of my own. This hand mill consists of two blades located at 120 degrees angle. The proper taper is achieved by mounting the strip on a wooden support. This support is elevated gradually to achieve the exact dimensions for the taper. This all took several weeks to finish and my results certainly could not be compared with professional tools like the Morgan Hand

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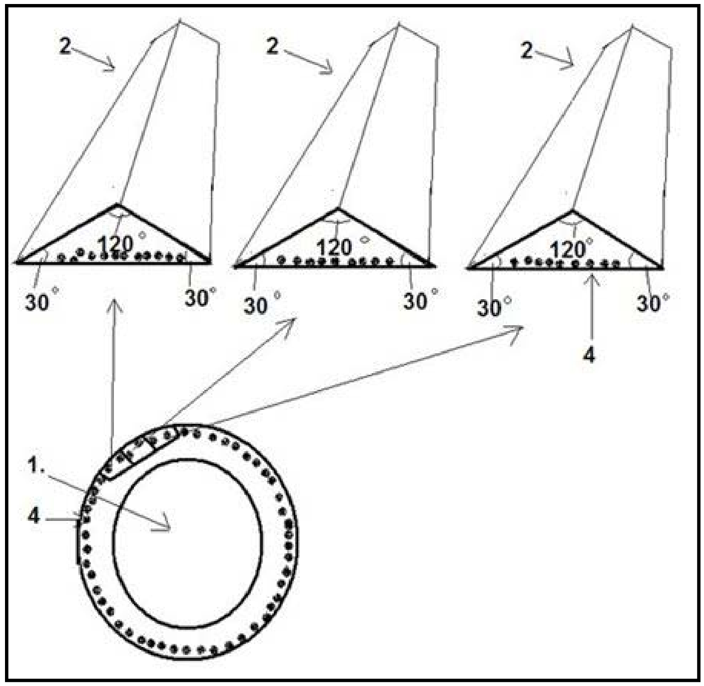
Mill. Later I have got a Baginski –type beveller with 120 degree angle (gratitude to Juha Jokinen). As I plane the soaked strips the sharp corners come out quite nicely without much tearing. Thus I had a construction system to make the strips with 30-120-30 degree corners and then glued my first triangular rod.



Three strips with 30-120-30 degrees for a triangle rod.

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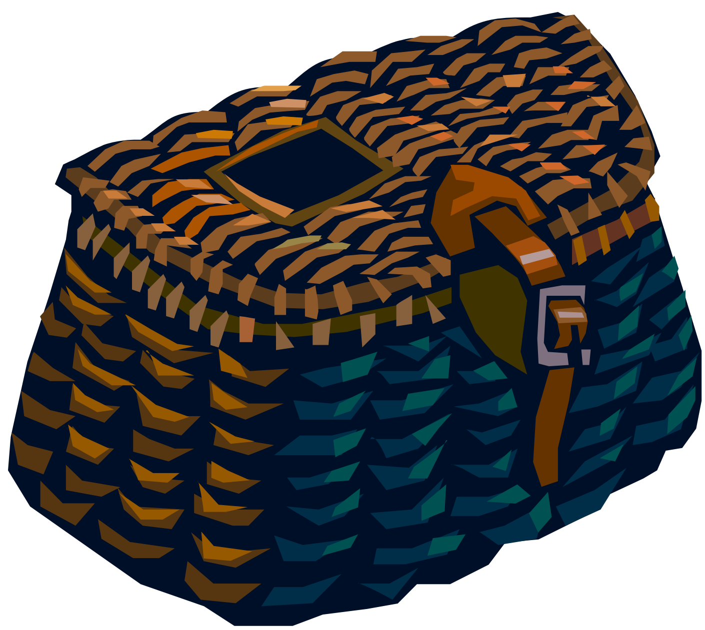
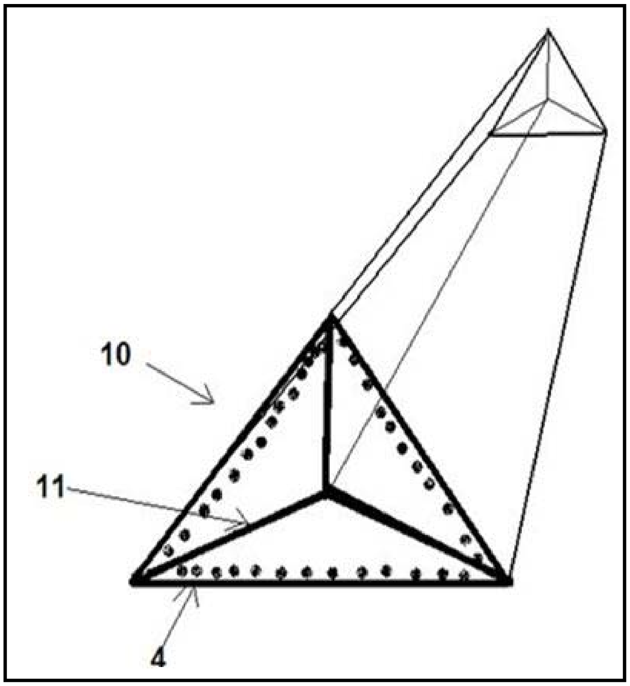
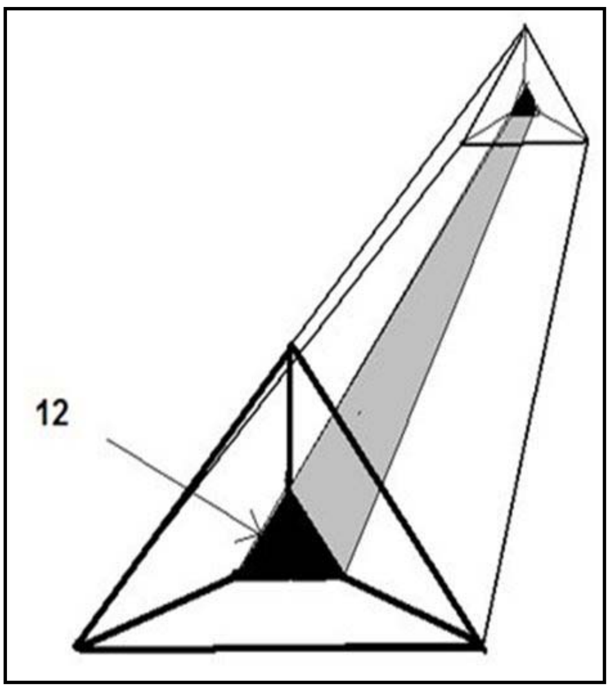




Three strips are glued into a triangle rod.



The hollow-built triangle construction.

I chose the first taper to be PH Young Driggs River Special (line weight #4-5). It was an easy and obvious selection because I have previously made several Driggs River rods using different constructions like hex, penta, quad, inside-out, hollow-built and with different kind of ferrules (bamboo, scarf joint) etc.

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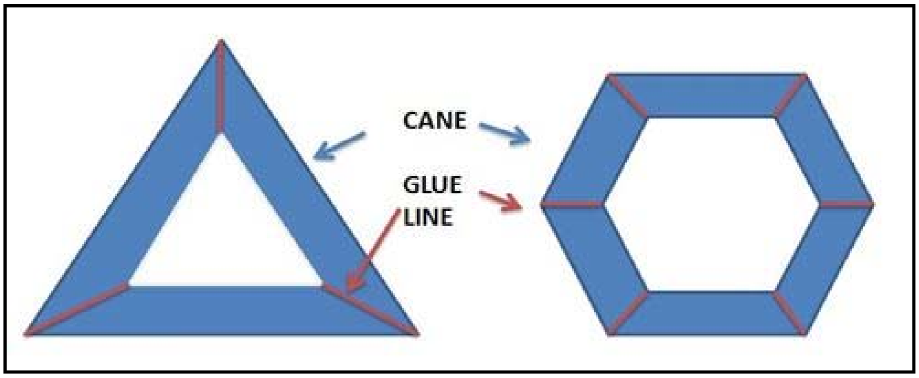
When the rod blank was ready I made the scarf joint ferrules and fixed the line guides onto the rod. To my surprise the triangular Driggs was not casting #4-5 line but #7 line - it was extremely stiff and much, much stronger than the equal hex rod. Now I rechecked the mathematic formulas of MOI of triangle construction and realized the huge difference between hex and tri construction both in theory and in practice.

As the difference was so huge I wanted to try to build longer and lighter rods. This has not been too easy, but I then tried to construct some straight tapers for 9-10' rod and 12-14' #8-#10 two-hand salmon rods using the mainly slow "trial and error" method.

The three strip triangle rod is easy to make hollow built. The glue line of a triangle construction is wider compared to hollow built hex. This gives extra power to the rod structure.



The glue lines of a triangle rod are longer and therefore stronger than those of a Hex rod.

Some cross sections of my three strip hollow built triangle rods.

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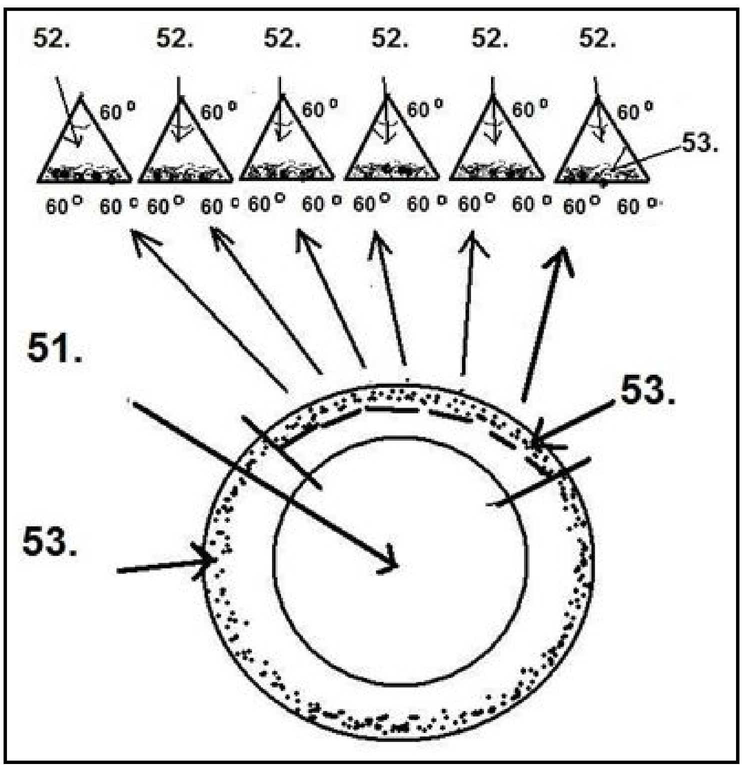
CONSTRUCTION II: TriStar –Triangle Rod Using Six Hex Strips

The schematic presentation of the six strips inside-out triangle rod.

As mentioned earlier, the Tri rods using the 30-120-30 degrees of strips were difficult and slow to manufacture using hand tools and therefore I decided to try another triangle construction.

The idea is to use six strips with normal 60-60-60 degree corners. The strips are then turned 60 degrees inside-out and then glued together. The strips are thus glued with the power fiber surfaces against each other. This results an inside-out hex rod. This hex rod is then modified into the triangular "TriStar" rod by planing the soft part of the strips away. I call this rod "TriStar" because the shape is triangular (Tri) and in the cross section the power fibers are arranged as a star shape.



Schematic presentation of the six strips for a TriStar rod.

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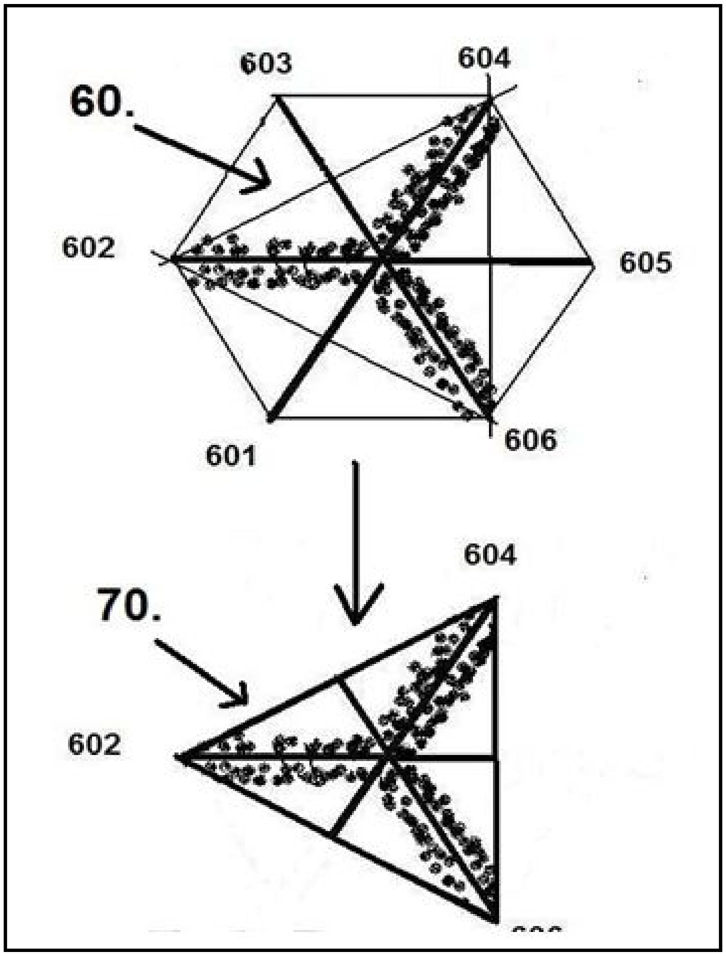

The six strips are glued inside-out with the power fibers against each other (60) and then planed to a triangle form (70).

Theoretically any HEX rod taper is very simply converted into TRI taper - you just multiply all the HEX dimensions with value of 1.40 (sqrt(2.0)). The resulting inside-out TRI rod is two times heavier than the original HEX taper. Then you plane 50% of the mass of the blank away as described. This results in a triangular rod of equal weight to the original taper. The stiffness of the new TRI rod is however much higher again. The rod is suitable for heavier line weight than the original taper; the difference may be 2-3 AFTM line weights as mentioned earlier.

The planing of the soft part of the strips makes same effect on the rod as hollow building. If you want to take 50% from the mass of the Hex rod you have to take 70% of the wall thickness (0.7x0.7= 0.49). This effect is thus achieved simply by planing in the TriStar construction. In addition the triangle structure gives higher MOI values.

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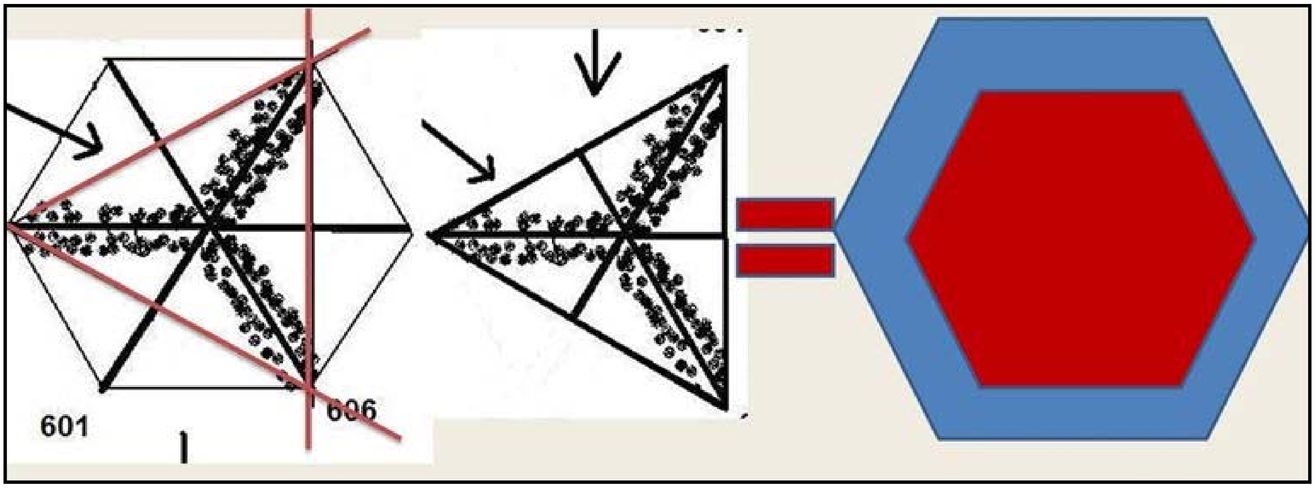

The effect of the triangle planing is equal to 70% hollowing of a hex rod.

When building thick salmon rods you would like to have very thick and strong cane. When manufacturing triangle rods using these constructions this is not required. Normal thickness of cane is sufficient for the triangle inside-out TriStar or three strip triangle rod. The extra thickness is planed away as demonstrated in Picture 12.

Some examples of my TriStar rod cross sections.

My present mathematic formula is to multiply the HEX taper values not by 1.40 but by value of 1.26 to 1.30. The more accurate tapers could be developed using the formula of MOI as the mathematical base. I have some tapers which I already have built and tested in fishing on my home page. The simple Hex_to_Tri_Calculator (Excel spreadsheet) may be also downloaded from my home page http://personal.inet.fi/private/tapani.salmi/ .

TriStar construction with inside-out structure gives an extra option for cane rod building. You may

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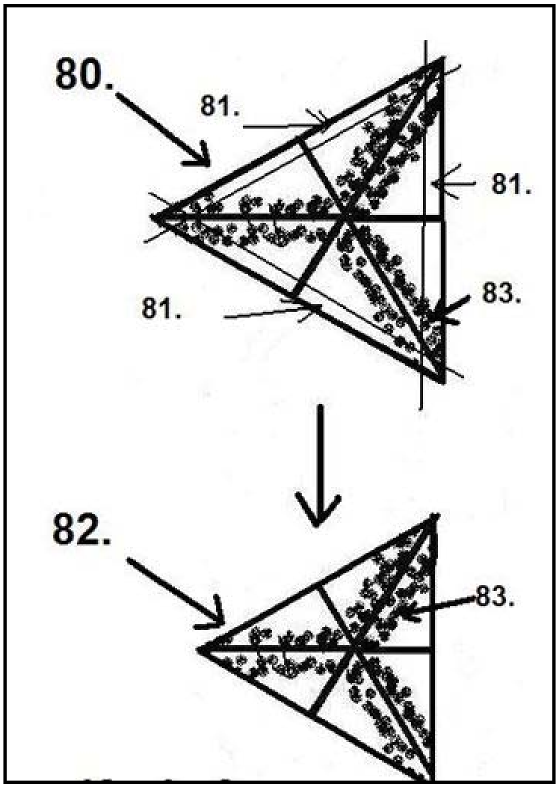
plane the ready glued rod thinner to change the taper and function. When planing an inside-out rod thinner you do not lose power fibers because they are inside the rod, not in the surface – see picture below.



The TriStar rod (80) may be planned to a thinner taper (82) without loss of the power fibers (83).

Other Features of Triangle Rods:

There are some obvious problems or even disadvantages in Tri -construction. The shape and outlook is certainly not usual and is even strange!

Ferrules

The construction of the ferrules is difficult as you have to change the Hex shape of the ferrules into triangular shape. For one handed rods I have used scarf (spliced) joints which are very light. In a scarf spliced joint the two sections are typically taped together. I also have built "plastic ferrules" to add to the scarf joint using shrink tube support - see http://personal.inet.fi/private/tapani.salmi/SCARFFERRULE.HTML

Another possibility is to make a bamboo ferrule. There are different techniques to make bamboo ferrules and the easiest perhaps is to use wide bamboo strips glued onto the blank and strengthened by

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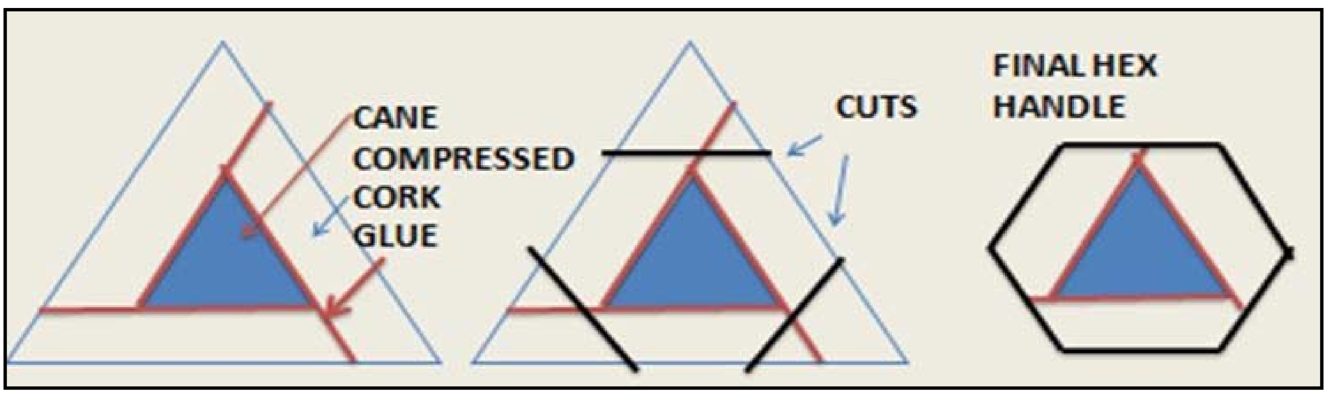
thread. I have used bamboo ferrules in my single hand rods with good success, but have not tried them in a two-hand salmon rod.

Bamboo ferrule of a triangle rod (left) and some scarf joint (spliced) ferrules with shrink tube support (right).

Cork handle



Schematic presentation of a HEX shaped cork handle of the triangle rod.

Even the cork handle is more difficult to manufacture for the triangle rod than with traditional rods. I have cut pieces of compressed cork plates (thickness e.g. 5 mm) and glued them to get 10 or 15 mm thick plates. This compressed cork is used on the floor beneath the parquet material. It is cheap and available in any parquet shop. As the compressed cork surface is not very hard, I wipe a very thin layer of PU glue on the ready cork handle. This results a pleasant surface with elastic feeling that is even softer than natural cork.

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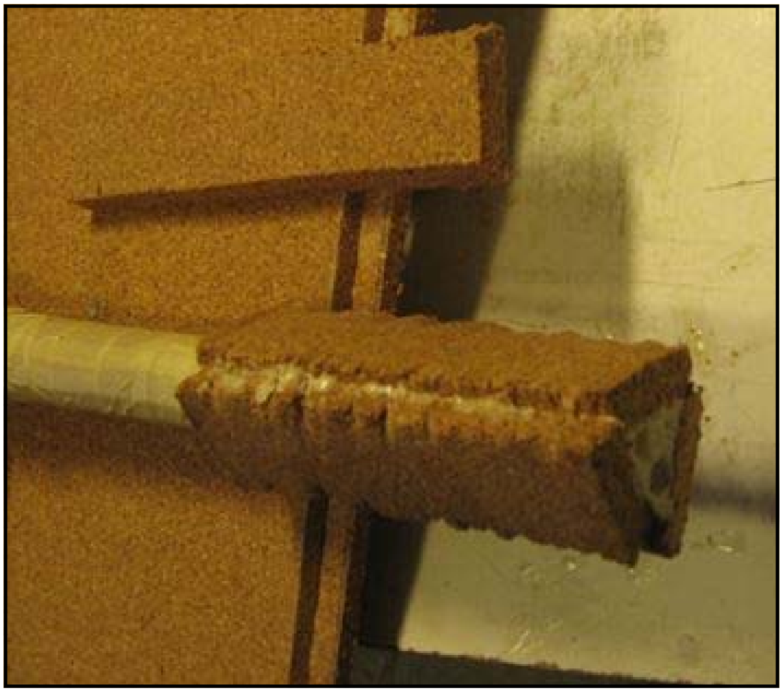

Compressed cork glued to the triangle rod.

Cross section of the cork plates glued with PU glue.

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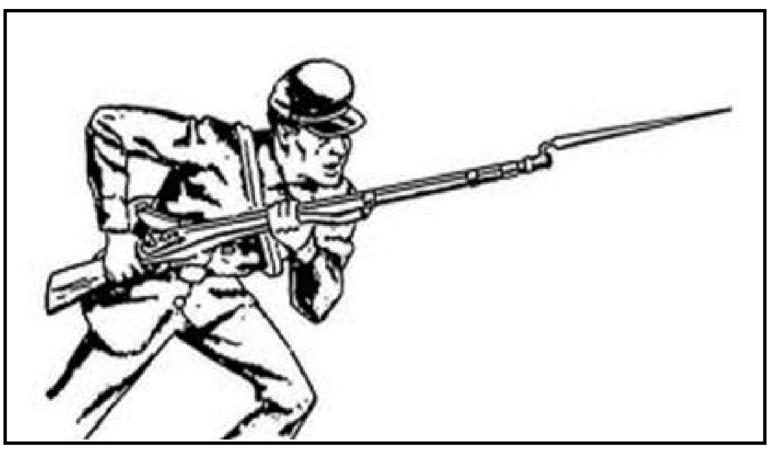
Final HEX shaped handles of two triangle salmon rods.

The triangular rod is not bending symmetrically during casting – it is a little stiffer and stronger when the rod is held with the sharp edge towards the casting direction. Therefore it is faster and stronger if you locate the line guides on the sharp edge of the rod and not on the flat surface. You have first to turn the feet of the snake guides a little to adjust the guides to the corner or to make simple guides of your own with proper geometry. I have made "single foot" guides of proper geometry using metal wire.

Bayonet Ferrule – Ugliest Ever?



The bayonet joint was earlier used for several purposes.

The first (lowest) scarf joint / ferrule of two hand salmon rod has to withstand a very heavy stress

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during casting without any "hinge" effect. Therefore the scarf joints have to be built with extra thickness especially in salmon rods. The first ferrule/joint seems to be the weakest point and not strong enough if the rod is hollow built. I have had some breaks of the sections near to the scarf joint after few days of casting. It could be strengthened using extra thickness of cane or using some firm supporting material, graphite. Therefore I now have used a very simple, totally different construction of the two hand salmon rod joints with very good experience.

To keep the triangle sections as strong as possible in the scarf joint I simply fix / tape them together directly without any scarf joint. The base of the first section is simply fixed to the base of the second sections. The joint is thick and very ugly but it is very strong. It is also shorter than the scarf joint and very simple to do. I call the joint "bayonet joint" or "bayonet ferrule," see picture below.

Bayonet joints of two triangle rods from above.

Bayonet joints with shrink tube supports.

In addition to the direct stress, spey casting makes heavy oblique stress to the joints and even the strongest tape seems not to withstand this. This causes an oblique hinge at the joint! Therefore I have constructed a simple metal wire support, "stopper" to the lower section of the rod to keep the joint as firmly fixed as possible. In addition, to fix the tape easily I have added a short piece of

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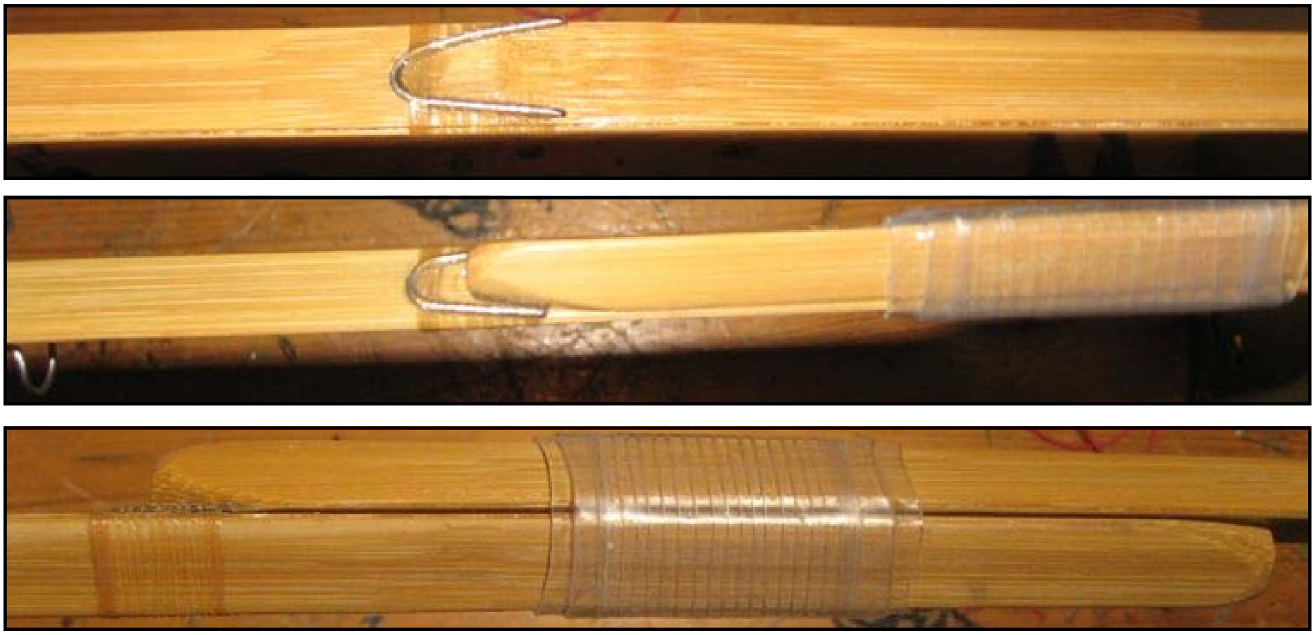
shrinking tube to the middle of the joint area. This holds the sections together when I start the taping. I hope that the pictures give you the idea of my bayonet joints.



Bayonet joint with shrink tube support and metal wire stopper for extra support.

Because of the bayonet joints the sections are turned 180 degrees compared to each other. Therefore line guides to first, second and third sections are on opposite sides in consecutive sections – again some new problems and challenges for the rodbuilder!

Two hand salmon rod (#9-10, 12.5’) with weight of 392 grams.

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Experiences

The development of Tri rod tapers has been time consuming as there are so many variables affecting the results and there are no ready solutions available. I have built long one-hand rods of 9-9 1/2'and I am especially happy with my two-hand salmon rods. They are very light and fast compared to my previous classic two hand rods. Now it is possible to cast so-called under hand casts using shooting head (Skagit line) and running line with my new rods. This feature is very useful on big rivers, with sinking lines and big flies for salmon fishing. When tested at the European Rodmakers Gathering October 2013, some experienced two-handed casters had difficulties casting the rod as it is much stiffer compared to hex rod of same weight. You really have to push the rod almost like a graphite rod to load the rod.

I really recommend you to try Triangle construction, especially if you would like to try longer and stiffer single hand bamboo rods or two-hand salmon rods. You are going to find totally new features in the very well known old bamboo material.

Two hand triangle rods used for Atlantic salmon fishing (Kola river, Russia) and the happy result.