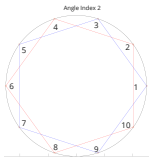
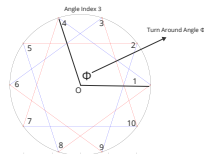
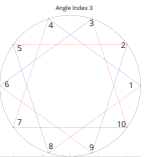


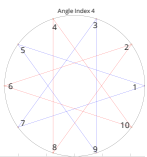
Draw any circle as a top view of a cylinder
Using selected filament width, circle can be divided to equal sections which corresponds to points on that circle.
Think of these points as the fins at each side of the cylinder.
By choosing a travel distance (Angle Index) which is one in this case, we draw connection lines from each node by starting from node 1
For every travelling, we change the color of lines between blue and red. So, each color shows direction respectively as forward and backward lines of winding.
To accomplish a successful winding pattern, all colored lines should be placed in an order between each other. Further, they should create a closed loop when all nodes are travelled and there should not be left any untravelled node in that loop
This (Angle Index 1) can be an example for a possible solution
Let's examine other values of travel distance (Angle Indexes)



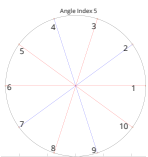
Angle Index 2 is a good example for unsuccessful winding pattern. Because it is created with two closed loops and each loop contains single color.



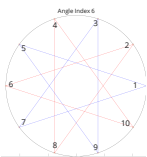
Angle Index 3 is another possible solution



Angle Index 3 is an unsuccessful winding pattern since multiple closed loop are occurred



Angle Index 5 shows an unsuccessful winding pattern and it occurs due to even node number



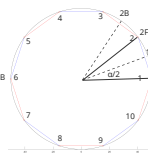
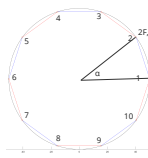
Due to symmetry, after index 5 pattern repeats itself

Important: node numbers do not equal to fin numbers of the mandrel. There are 3 types of solutions. 1 for even fin numbers and 2 for odd fin numbers.

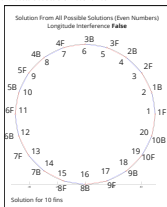
As you can see from this example, there are 10 nodes but only half of them are backward and vice versa. So this means you need only 5 fins for each side of the mandrel.

Let's assume fins as a longitudes in 3D space, angle between each longitude defined as alpha. So by multiplying fin number by 2, we are shifting one side's longitudes by $\alpha/2$

So what this means is, if you want the calculate solution for even fin numbers you need to multiply fin number by 2 to find node number. As you can see from the example, now there are 10 backward and 10 forward lines and we can use all of them from top view as hidden lines because longitudes are shifted.



To find a solution for 10 fins, we should shift one side's longitudes by $\alpha/2$



For even numbers there is 1 solution;

Node number = 2 * Fin number
which longitudes are not interfered with each other

For odd numbers there are 2 solutions which are;
Node number = 2 * Fin number
which longitudes are not interfered with each other

Node number = Fin number
which longitudes are interfered with each other
For odd numbers, this equation still is a success because when you travel all nodes you have still 5 backward and 5 forward lines.

