



THE INFLUENCE OF THE KNOT TYPE IN THE HYBRID MODEL LINE-FISHING HOOK

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Abstract: Numerical simulation of the hybrid mechanical system line-fishing hook is based on some physical parameters, like the angle between the line and the shank of the hook. The main influence on this angle is done by the knot type, the hook shape and other factors. This article studies the influence of the knot type on the main angle line-fishing hook.

Keywords: fishing hook, knot, mechanical testing

1. INTRODUCTION

The fishing hook characteristics were discussed in a previous article [1] and some classifications were proposed to improve qualitative and quantitative analysis with finite element model. However, the geometry of this very interesting model line – fishing hook is influenced by many variables. Let's take a closer look on the main angle α , the angle between the line and the shank of the hook [1]. It seems to be simple to identify this angle, but in practice there are so many methods to tie the knot which introduces a lot of variables. It seems reasonable to fix some parameters, like the nature and the diameter of the line, and the type of the hook, in order to perform the study of the geometry.

A general situation is the case of a straight shank with plane end. This reduces considerably the study, as the braided knots used for the hook with eye end are many. Also, the hook with an eye at its end should be simulated as a spatial articulated body. If the hook end is simple and plane, the line starts from the shank like from an articulation, but obviously there is not a perfect articulation. Here could be introduced another parameter, the nature of the hook. If the hook is made from wire, we should consider a circular shape of the cross section, but if the hook is forged, the cross section will be generally a rectangle. We did choose to start the study with the common hook made from wire.

2. ANALYTICAL MODEL

As it was presented in [1] and [2], assuming the load Q is applied in the worst case, exactly in the point of the hook, as in figure 1, the bending moment is a function of the parameter ε – the angle that indicates the current transverse section of the hook, starting from its point:

$$M(\nu) = -Q \frac{d}{2} (\sin \nu \sin \gamma + \cos \nu \cos \gamma - \cos \nu \cos \gamma) \quad (1)$$

The maximum bending moment appears for the critical value of the ε angle

$$\varepsilon_{cr} = -\arctg(\tg \gamma) = -\arctg \frac{d}{a} \quad (3)$$

For the second step, let's assume a more general value of the angle α as a complex function of material and knot type. The equations remain the same, but the value of the angle α will be obtained from experimental analysis and the angle α is no longer a function of the shape parameters d and a .

The variation of the function $M(\varepsilon)$ for an unit force Q and unit distance d , assuming a value of ε angle of 1 decimal degree is presented in figure 2. The parameter α starts at 10 decimal degrees (0.15708 radians) and stops at 45 decimal degrees (0.70685 radians). This interval was observed in practice to cover, in general, the values of angle α .

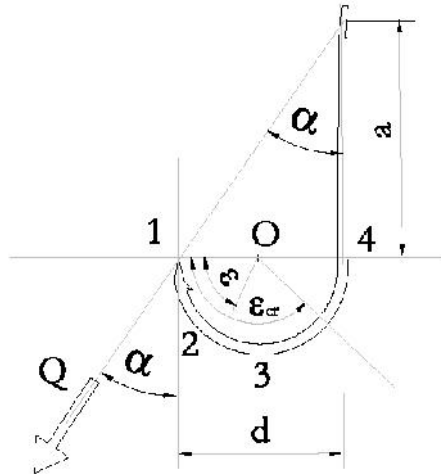


Figure 1: General geometry of the hook

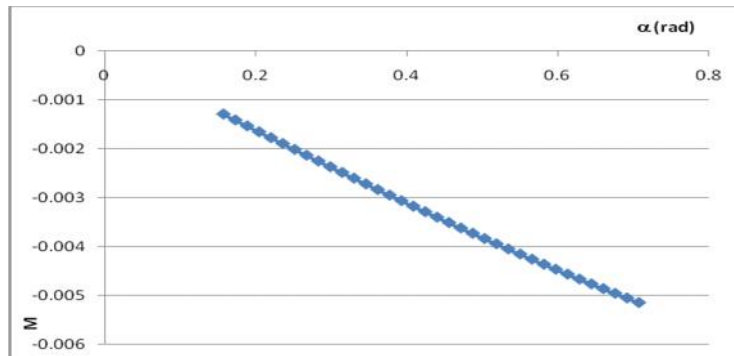


Figure 2: The variation of the bending moment M for $r \in [10...45]$ decimal degrees

In conclusion, the α parameter has an important influence on the bending moment. For this reason it is necessary to carefully observe its values in different situations.

Generally, knots are not as strong as the line. In fact, a knot weakens the line up to 50 %. The problem is to choose the right knot, but it seems there it should be compatibility between knot, line (function of nature of material and diameter) and the shape of the hook. In this study we tried to identify some mechanical parameters of this complex assembly line-knot-fishing hook.

3. EXPERIMENTAL SETUP

The method used to tie a simple knot for a plan end of a hook is presented in the figure 3 and 4. Note the position end the mode the line goes parallel to the shank and specially the mode it continues at the end of the knot.



Figure 3: Knot K1

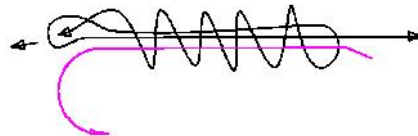


Figure 4: Knot K2

The knot named K1 present a curl at the end and the line pass trough, so finally the line will take a direction other than the shank (figure 5). The knot K2 allows the line to continue parallel to the shank. The difference is observed directly on the angle α values, as the line movement is restricted, depending on how the line starts out from the knot.

If we examine the knot, we can observe three relative positions of the line and the shank, as in figure 5.

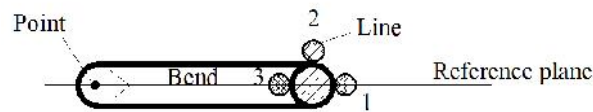


Figure 5: The relative position of the line and the shank of the hook

In order to measure the value of the angle α , the two knot K1 and K2 were tied, using three position of the line like in the figure 5. When the knot is tied, usually the angler puts the line in the position 1 or 3. The position 2 is also possible. It should be mentioned the knot is able to move around the shank, under great variable loading, especially when it is used a polymer line.

The line was a fluoropolymer, type monofilament, 0.30 mm, and the hook was a Mustad, 220 A-NI Hollow Point Crystal, size 6 [3].

The load was applied in two situations: firstly on the bend (considering this is a general case), and secondly, directly on the point of the hook (an extreme position, but also possible).

Some loading situation are presented in the figures 6-10.

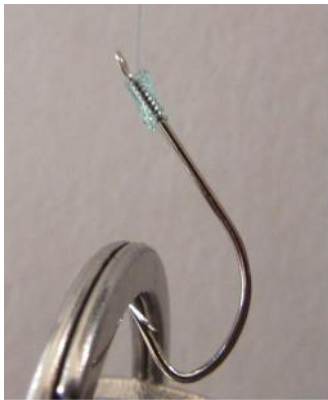


Figure 6: K1 position 1, point



Figure 7: K1 position 3, bend



Figure 8: K2 position 1, bend



Figure 9: K2 position 3, bend



Figure 10: K2 position 3, point

The average α values measured are presented in the table 1.

Table 1: Measured values of angle α

Node	Position	Applied load	Angle α decimal degree	Node	Position	Applied load	Angle α decimal degree
K1	1	on bend	22.70	K2	1	on bend	25.60
	2	on bend	19.40		2	on bend	19.30
	3	on bend	17.60		3	on bend	19.60
	1	on point	37.45		1	on point	36.30
	2	on point	27.75		2	on point	29.90
	3	on point	27.40		3	on point	27.70

The first position of the line allows the biggest value of the α . The second position leads to intermediary values. The third position force the line to start out over the plane end (or the eye, if exists) and this diminish the angle α . In general, the knot K2 generates greater values of α . Here was observed an exception, for loading applied on the point, position 1, when the angle is greater for the knot K1.

3. CONCLUSION

The main factor which influences the value of the bending moment for a fishing hook is the angle α . The values of the α parameter were experimentally observed for two types of simple knots. The angle α depends on many factors. In this study more parameters were fixed, in order to look carefully at the influence of the knot, the line positions and the point of application of the load. The next factor to study is the shape and the type of the hook and others.

In this experiment, angle α varies from 17.60 degrees up to 37.45 degrees. This means a variation of the bending moment almost from simple to double (104 %). Note the analytical expression of the bending moment is deduced in pure bending hypothesis for a beam of constant transversal section. For the FEM simulations, a value of angle should be considered according to real use of the fishing devices. The higher is the value of the angle α , the higher is the value of the bending moment for the same hook.

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