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The Dynamic Modelling of Vortex Axis Blade between Speed、Force and Rotation under Variable Angle & Power in Helicopter

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Abstract

In general the lift speed and force becomes is investigated with the rotation. In an entire course it exhibits in their curve. The speed changes into being little when the pitch angle become big. The largest wing force for one blade is 73KN when power is 3556KW at 50° that expresses the big wing force for helicopter engine. This is the summit with low rotation by engine, and then the value will maintain 5~10KN sluggishly. Another is considered that the big angle of attack will incline force which is a significant find in this study. The additional one is power and the force becomes big with high power. The elevating force is the biggest with 230KN for one blade at power of 3566KW.

Keywords: Modeling; Dynamics; Speed; Force; Angle of attack; Power; Helicopter

Introduction

The speed and force is to be found the necessary parameters in blade mechanism movement in kinematics of helicopter. So in a cycle the investigation into kinematic movement is important. Firstly through speed of helicopter exhibits the force size directly. It is observed through curve tendency. Secondly the force expresses the force through detail tendency. It is expressed that define value of force change. In order to save material and cost the data on them is essential at all. Such as the detail material choice and manufacture cost is needed reasonably and economically. In this paper the speed and force is computed through model and it is valuable on their data and tendency. Further research is needed to these parameters behavior to grasp these rule and data. Because the helicopter is applied to many factories the blade is an important mechanism in punch component. So the speed of work is most important one to control the production. We shall compute and model the parameter to find an economic mechanism to its application to product designer, operating engineer and machine maker [1-4]. The dynamics can be used in blade and blade parts, because its piston can work through them. On the final speed of 3000r/m which is the helicopter cycle speed in general the helicopter is to be compared with it for preventing from traffic accident if it is beyond the helicopter cycle. In the process of designing, the piston press are connected into their procedures, and in a short time to complete the continuous processing of the piston circulation. They produce a lot of products in a certain amount of time. Since they are an automatic movement helicopter, it is difficult to control the control. So we should focus on this control issue and work for scientific management, networking and digital design and management. Due to excessive piston and blade mechanism fatigue, and the piston processing speed is also fast, we need to carry out timely routine inspection of the engine and focus on the hidden faults. This saves the cost of the inspection to the manufacturer's personnel for repair due to machine failure and the loss caused by the fault of the machine. Because the load and frequency of the mechanism does not keep up with the loss caused by the fatigue condition under the load of the helicopter engine in special, the economic efficiency of the control structure of the blade with related parts is an important factor in the helicopter [5-7]. The force is the most important parameter with

certain angle of attack which determine its stay and forwards in air. This paper discusses the blade from the technical view of economic benefit. The blade is the most critical transmission power mechanism, which turns the rotating motion of the blade by rotation of the engine and wings and supports the helicopter. Therefore, the kinematics and dynamics of the blade are studied in order to optimize the blade parameters and high efficiency.

Kinematic Equations

It has

$$dv = d(\pi Rn/100)\cos(\alpha+\beta),$$

$$dF_n = \frac{36P\sin(\alpha+\beta)}{\pi R}d(1/n)$$

And $dF_l = Pd(\frac{1}{v\cos\phi})$

Here as seen in n is rotation in blade, r/min; R is blade radius, m; α is angle of attack, °; β is pitch angle, °; ϕ is the adding α and β angle, °; P is the power, KW; v is lift speed, m/s; vl is resolution elevated speed, KN; Fn is the wing force, N; Fl is lift force, N (Figure 1).

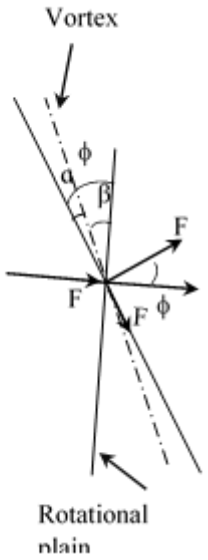
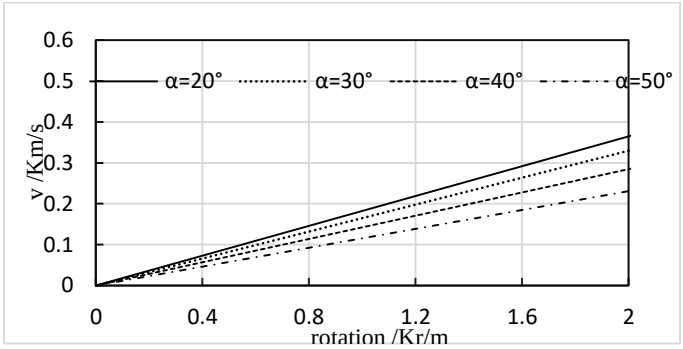


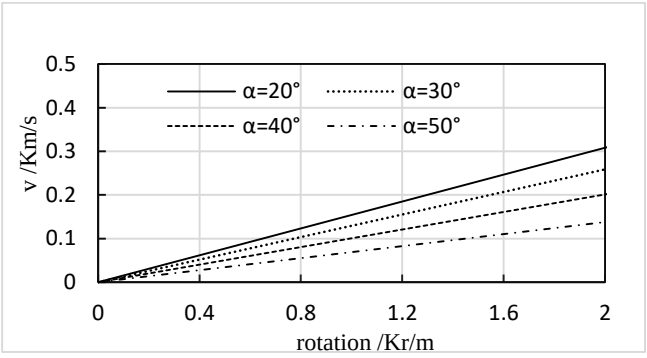
Figure 1: *Schematic of helicopter s force resolution.*

Discussions

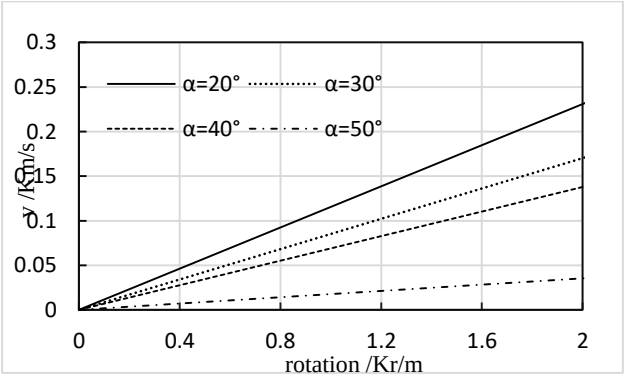
It is investigated that what the speed changes when angle of attack inclines from 20° to 50° in helicopter meanwhile what the speed changes when the helicopter becomes from 1566KW to 3566KW during one cycle course time is detailed explanation in this study. The size of blade length is chosen for optimum helicopter. It is investigated that 50° is the best one since its energy saving is attained by the big angle in this study. It shows the maximum force with 3566KW. The high efficiency is high one with big angle of attack and low rotation which causes high force and rapid work to apply to. Big load with high force and speed movement is attained. It may be deduced from the formula which can incline the force correspondingly too. Shows that the lift speed of helicopter becomes inclined when the rotation changes into increase with a certain pitch angle β of 5º,20º and 35º (Figure 2).



(a) β= 5º



(b) β=20º



(c) β=35º

Figure 2: *Relation between the lift speed and rotation with angle of attack at radius of 6.7m.*

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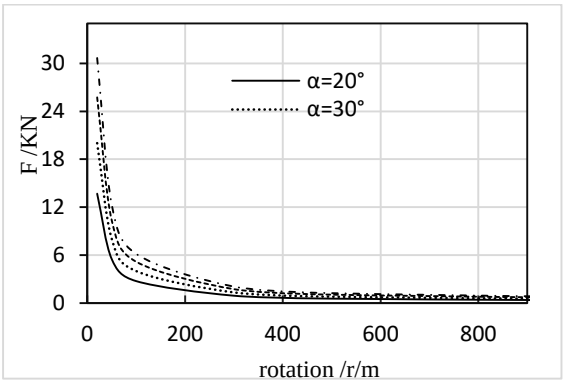
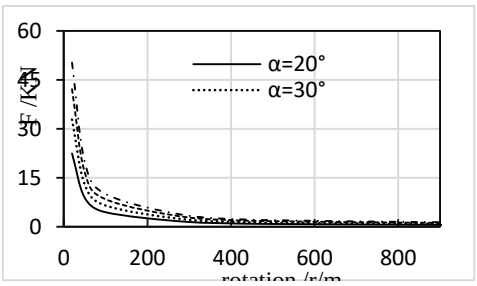
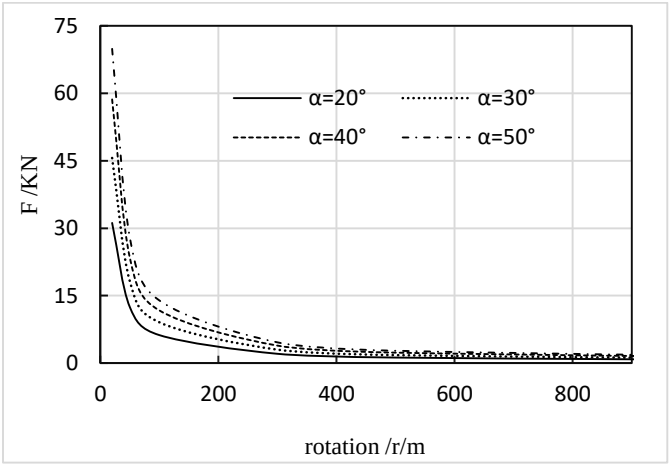
Meanwhile the speed changes into being little when the pitch angle become big. It will be from zero to positive value proportionally. When blade length is 6.7m and angle of attack is 35° the highest movement is formed, then it is 50° with lowest movement. Here the role of rotation and angle of attack is somewhat big and main is rotation and they angle of attack in terms of the figure. It shows that with increasing rotation from 0 r/m to 10E+4 r/m the speed becomes 2E+3 m/s.



(a) 1566KW



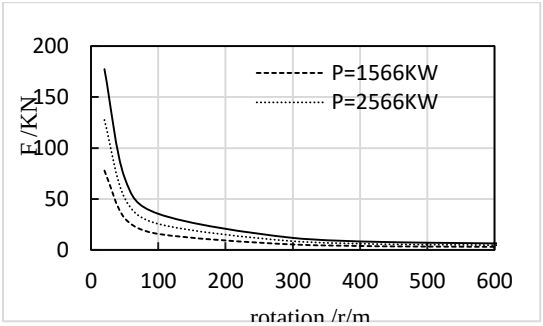
(b) 2566KW



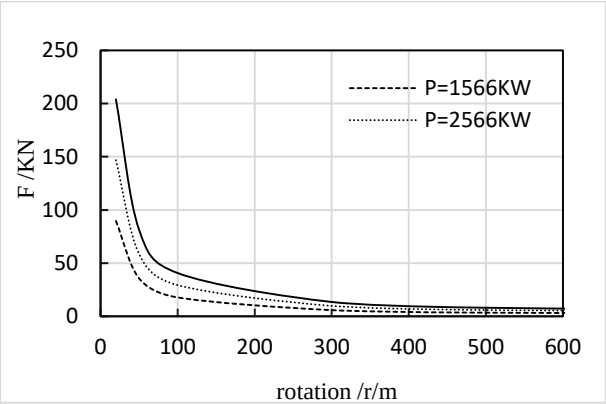
(a) 3566KW

Figure 3: *Relation of wing force and rotation with angle of attack and power by one blade.*

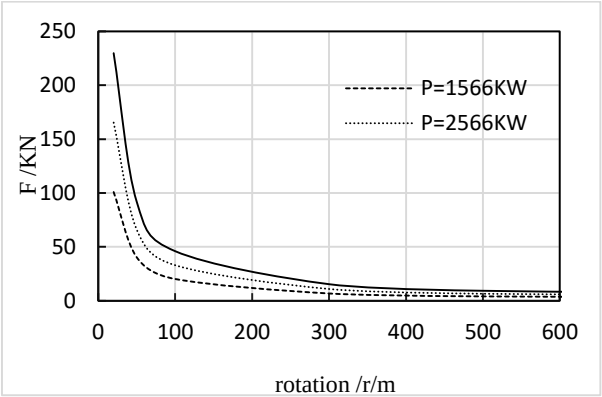
Overviews with decreasing angle of attack it becomes big, and with increasing rotation it will decline about 200m/s when the angle increases gradually. It shows that speed effect is in relation to the changing angle of attack in this study. Shows that the wing force will be with the rotation at P=1556KW, 2556KW and 3556KW (Figure 3). Here five blades is used to calculate in this paper so the value is one blade's one. The one with 3556KW is large them 2556KW and at last 1556KW. That's saying that more big force is gained with declining rotation. The force happens with 73KN of the biggest value with 50° of angle of attack at 3566KW. In opposition to it at high 3556KW in Figure 2（c）the wing force attains 14KN at 20° then the difference of 15KN is with angle being 30°,40° and 50°. At 70r/m and the sluggish curve will form. Since one vortex axis blade is adopted from five blades the force will be five times of this figure. As to the helicopter the force for propel attains 73KN ie. 7.45tons at 50° of angle of attack and power 3566KW which is confirmed here. However it attains 32KN at same angle and 1566KW. The minimum force is under 20° and 1566KW and it attains 14KN ie. 0.143tons under this condition. The mediate one is at 30° and 40° & 2566KW, its wing force attains 32 KN and40KN respectively. To compare with their gravity from 10 tons and 20 tons this is a equivalent wing value. Considering there are five blades the total wing maximum force will attain 70KN for one at 1566KW and 20°. In it shows the curve of elevating force and rotation (Figure 4). The same condition as five blades is supposed and only one blade is shown in this paper. The condition in this study is P=1556KW, 2556KW and 3556KW and angle of attack α=20°, 30 and 40°. The similar status will be found too to compare with Figure 2 except the high force. It is here to be mentioned that elevating force is the biggest with 170~230KN at power of 1566KW~3566KW. That means that the high power will be formed at low rotation. The rotation of 70r/m is needed in heavy load such as the load goods and person even slope climb in driving operation. The force will be low steeply to 20~50KN ie 2~5tons in Figure.



(a) α=20°



(b) α=30°



(b) α=40°

Figure 4: *Relation of elevating force and rotation with angle of attack and different power by one blade.*

If the rotation is big the speed of helicopter becomes big. So increasing rotation is to decline helicopter force from 0r/m to utmost, it is one way to regulate. On the other hand with increasing angle of attack the force of elevation will become big as well. If the heavy load attains the near capacity of helicopter it is needed to regulate the angle of attack and rotation, that's saying increasing the angle of attack and decreasing rotation properly to promote the maximum capability. So that regulation of increasing angle of attack is to increase the elevating force in a helicopter. Both of them are important to control the helicopter speed and force in designing helicopter. Here one blade is used to model so total elevating force is 5 times. Such as the elevating maximum force is 80KN at 1566KW and α=20° so the force of whole helicopter will be 400KN, ie. 40.8tons.

Conclusions

The speed of helicopter becomes big proportionally when the rotation changes. With the decreasing pitch angle the helicopter's lift speed becomes big. When the rotation is big the speed shows big too. At 70r/m the stable force will be formed. When the rotation is big the force declines from 0r/m to1000r/m. As angle of attack goes up the force will be big. So to incline the force it is chosen of low rotation and high angle of attack, the former is the declining cost methods. The wing force happens with 600KN of the biggest value with 50° of angle of attack at 3566KW.

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