



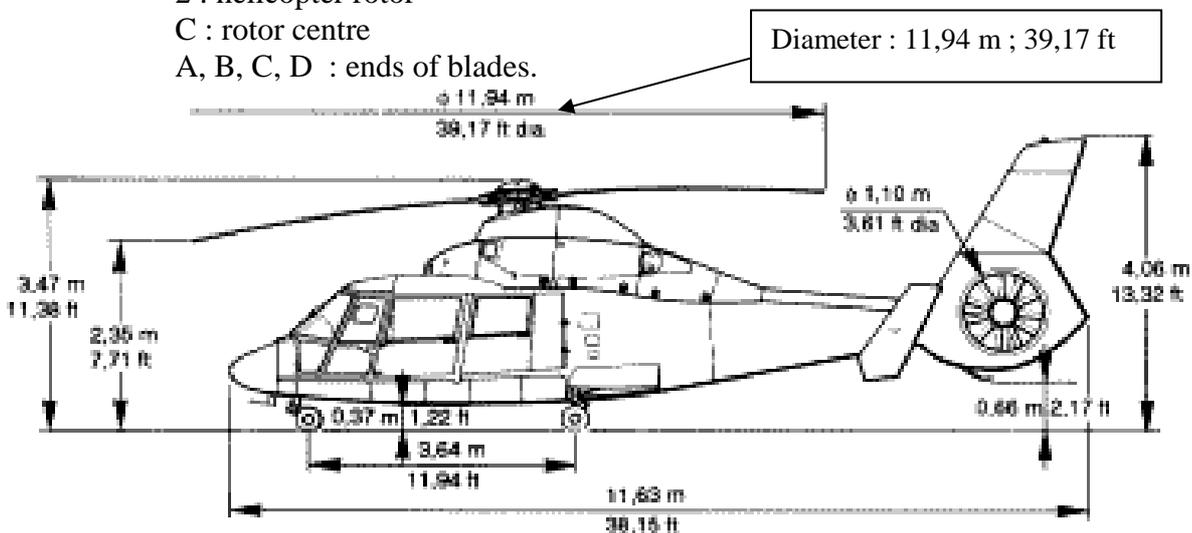
This study is about the DAUPHIN built by the EUROCOPTER Company.

In order to avoid fatal deflagrations at every rotation, the end point of the blades mustn't break the sound barrier.

We will therefore determine the maximum rotation speed of the rotor for the blades end not to exceed that limit when the helicopter flies at its maximum speed.

1. Data

- Max speed of helicopter (at full load) : $V_M = 277 \text{ km/h}$
- Sound speed in air at low altitude : $V_s = 340 \text{ m/s}$
- Labels :
 - 0 : ground
 - 1 : helicopter fuselage
 - 2 : helicopter rotor
 - C : rotor centre
 - A, B, C, D : ends of blades.



2. Proposed work

2.1. Position of blade at maximum speed

From above, the rotor turns clockwise. Trace on the top view the path of the end point of the blade with regard to the fuselage.

2.2. Speed of the extrem point of the blade with regard to the fuselage

The turbine drives the rotor at the frequency of $N_{2/1} = 350 \text{ tr/min}$

Calculate the magnitude (in km/h and in m/s) of speed vectors : $\vec{V}_{A \in 2/1}$, $\vec{V}_{B \in 2/1}$, $\vec{V}_{C \in 2/1}$ et $\vec{V}_{D \in 2/1}$.

Represent them on the view in..... (choose a color)

2.3. Ground speed of the helicopter

It is assumed that the helicopter flies in straight line at its maximum speed.

Calculate the magnitude (in km/h and in m/s) of speed vectors : $\vec{V}_{A\in 1/0}$, $\vec{V}_{B\in 1/0}$, $\vec{V}_{C\in 1/0}$ et $\vec{V}_{D\in 1/0}$.

Represent them on the view in..... (choose a color)

2.4. Ground speed of extremity of blade

Recall the law of composition of speeds :

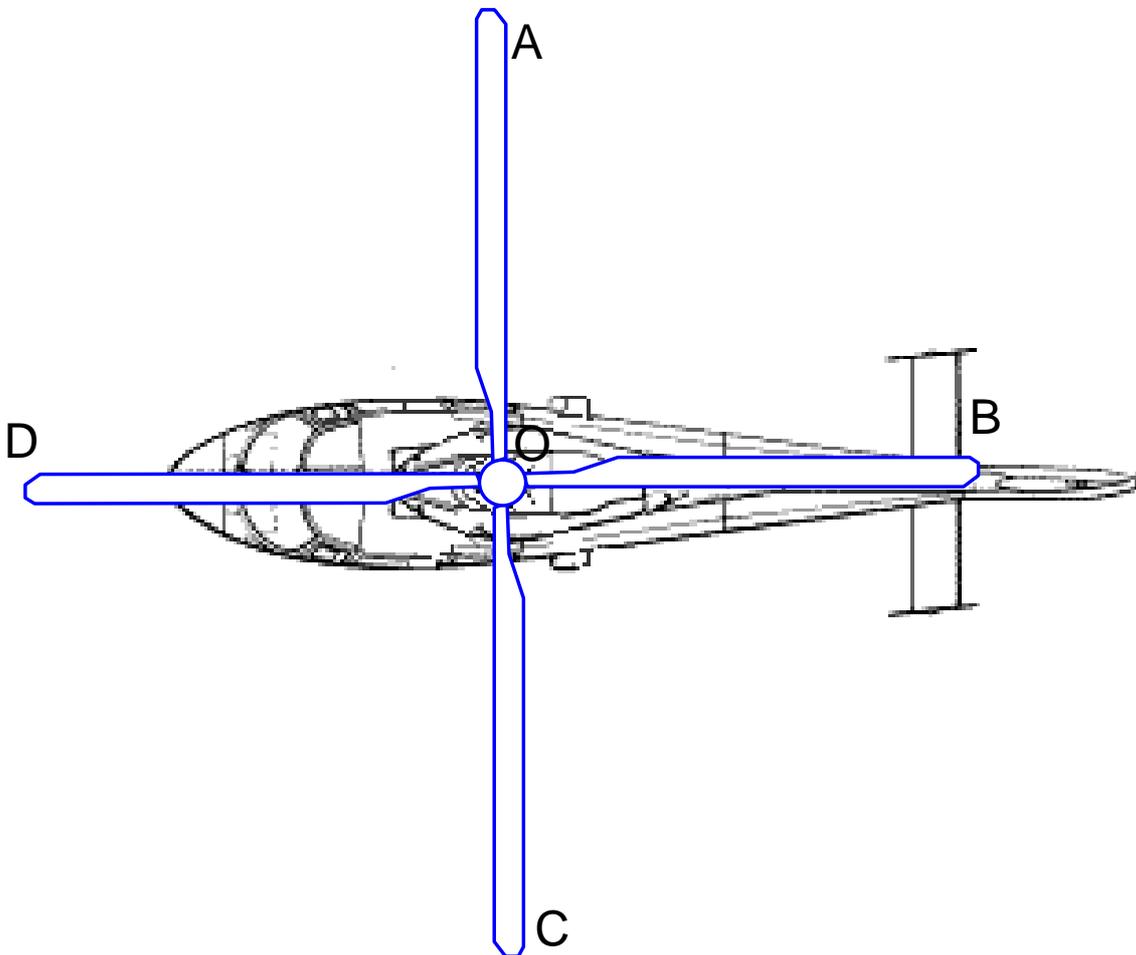
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Then construct in *.....the speed vectors $\vec{V}_{A\in 2/0}$, $\vec{V}_{B\in 2/0}$, $\vec{V}_{C\in 2/0}$ et $\vec{V}_{D\in 2/0}$.

*(choose a color)

In which point is the magnitude at its maximum ?

Calculate that magnitude :



2.5. Maximum rotation frequency of the rotor

What is the maximum rotation frequency $N_{2/1Max}$ (in rpm) of the rotor in order to avoid breaking the sound barrier at the end of the blade ? Write your answer at the back.