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EFFECT OF ROTATION ON THE STRUCTURE OF TURBINE KAPLAN ROTOR

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ABSTRACT: The motion of a fluid around a body of any shape.This phenomenon occurs when there is an area along the contour of the body has a tendency to increase pressure. This effect is felt when rotating turbine rotor.

KEY WORDS: turbine, Kaplan rotor, boundary layer, motion of fluid.

1. Introduction

Fluids regimes that form the moving blades of a turbine rotor cause critical system characteristics and aerodynamic forces.

Regime depends mainly on the shape of the profile, the angle of incidence and Reynolds number attached flow.

$$\mathrm{Re}_x = \frac{U \cdot x}{\upsilon}$$

Regime of fluids depends on the Reynolds number built outside the current velocity and a characteristic length, measured from the leading edge around body surface and kinematic viscosity of the fluid flow.

Phenomen that describe the effects of the fluid layer on the palette are the ratio of the radius and its chord length r / c and rotation parameter ω. Rotation parameter is a measure of the interaction between axial velocity (wind) and flow-induced rotational rotor blades. The physical mechanism which causes all three-dimensional effects is related to the interaction between the wind speed exceeds design speed and ambient air flow induced rotational constant rotor speed.

If the rotation parameter is less on the broad:

$$V_\omega < \acute{\Omega}_r < 1$$

lades are twisted properly, the flow is generally attached neafectatata this one. But the blades of wind turbines often work in conditions:

$$V_\omega < \acute{\Omega}_r > 1$$

causing peeling range limit.

2. Experimental methode

Values of the rotation parameter leads to increased flow rotation in the central hub which results in large negative values of pressure reduction (reduction section) at the leading edge separation bubble and producing slats instead of separation (stall) slats. In addition, Coriolis forces induce favorable gradients chord direction, helping to delay separation (stall-delay). The production of this phenomenon called "stall - delay" interior, characterized by sudden rise Lift and drag can be attributed to rapid wind suction air bubble detachment on board the flight and directing it in the radial direction. Flow near the trailing edge of a blade sections in the critical regime is sketched in figure 1.

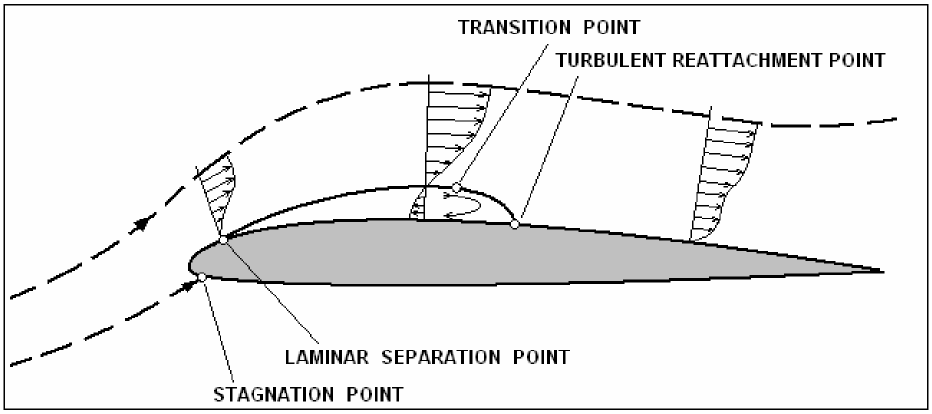

Fig.1 Flow near the leading edge.

Laminar boundary layer is formed from the stagnation point of the leading edge then detaches immediately downstream of pressure points. Then transition to turbulent flow occurs downstream shortly after laminar separation. Next flow reattaches itself sectional surface turbulent boundary layer that extends to the trailing edge.

Near the center of rotation and the leading edge, the local detachment surface vorticity generates intense theoretical point type singular focus that moves after trajectories spiral flow. In these conditions, the study dimensional separation process can be treated advantageously with the boundary layer equations and a troubleshooting reverse them.

The results for bubble detachment aboard the attack suggests a plausible explanation for the increased rotational aerodynamic forces. An important element of this analysis is to determine the area of the region drawn from the blade leading edge.

The assumption of linear variation of velocity gradient is negative in many instances satisfactory approximation of the actual operation and can be used to simulate the velocity distribution near the trailing edge of a turbine blade Extending flow after separation with a relaxed flow that maintains around the leading edge in a flow separation is a satisfactory approximation to the real flow allowing the use of boundary layer model for the analysis of the three-dimensional separation.

Figure 2 gives the variation coeficientuluide wall friction will influence the fluid flow separation and reattachment.

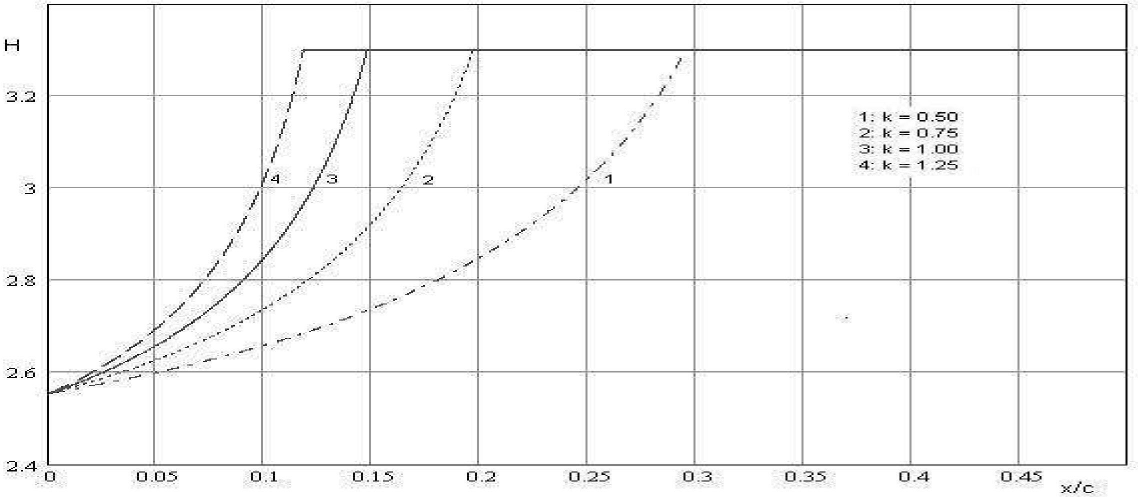

Fig. 2. Variation of the wall friction coefficient and the boundary layer shape parameter

In figure 3 shows the results of flow flow in critical conditions, the detachment and reattachment of fluid curentuluide leading edge in terms of speed.

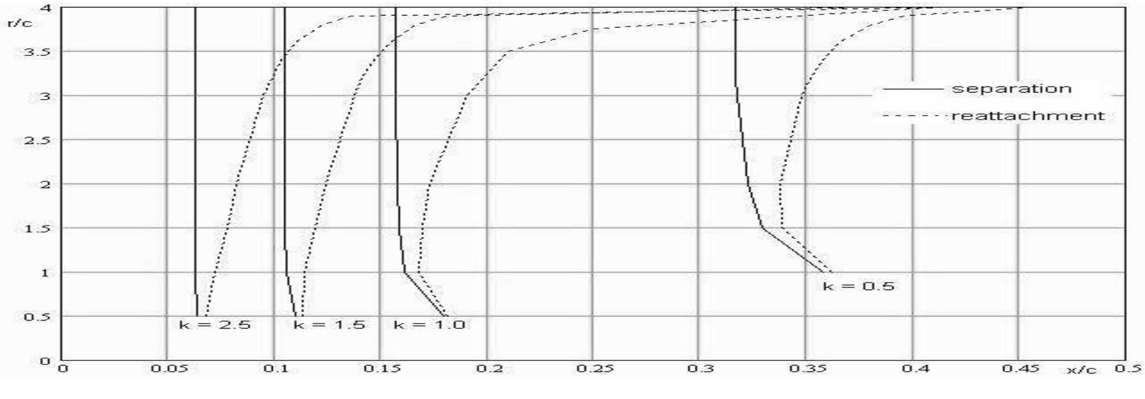

Fig. 3. Coefficient of detachment / reattachment slats calculated
for different values of the velocity gradient, k.

In the method described four cases were analyzed by flow pressure gradient conditions. The results for the coefficient of friction at the wall in the chord direction to the boundary layer shape parameter and power lines limit angle at different values of the parameter small areas of boundary layer separation and reattachment

dimensional. In the cases considered, the specter of separation and attachment lines suggest the presence of a bubble vorticity pronounced bevel on the inner half of the blade. After the bubble breaks at the leading edge forms a friction free layer and the extrados blade flow is mainly in the radial direction toward the blade tip.

3. CONCLUSION

The main conclusions are as follows:
1.Structura detached flow on the rotating blade in critical conditions depends mainly on three important parameters: r / c, Vw / Ωr, Re, r / c and Vw / Ωr have a powerful effect on the production of three-dimensional separation bubble on board blade interior attack, while the flow detached slats on the outside of scope depends especially on Re.
2. Configuration power lines limit the hub (r / c ≤ 1.0) is given by convergence, which implies a singular point in complex structure: a combination of focus and point to. From the physical point of view, this is the beginning of the separation bubble at the leading edge, which triggers the three-dimensional and rotational effects.
3. Accurate prediction of aerodynamic performance in critical conditions must take into account the effects of flow-induced additional scale direction.

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