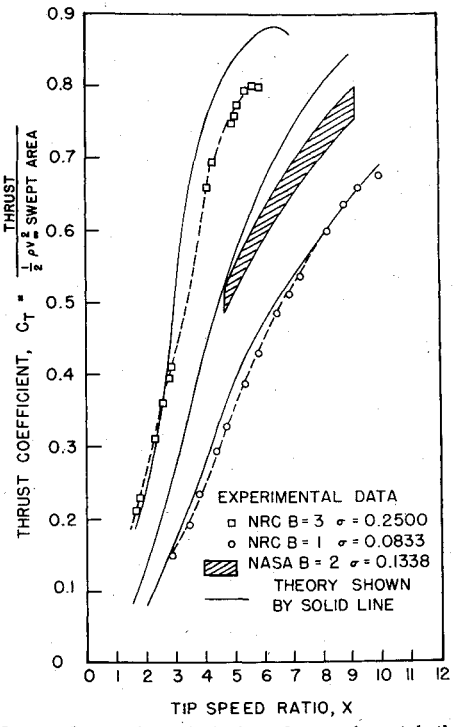

Fig. 3 Comparison of analytical and experimental thrust coefficients for a Darrieus rotor.

three blades. The blades used in these studies were NACA 0012 sections having about a 6-in. chord. The resulting Reynolds numbers for the blades were of the order of $3 \cdot 10^5$. References 6 and 7 were used to check the analytical formulations of Templin, Muraca, and Wilson and Lissaman. The later analytical formulation was found to give the best results when compared to the data. Figures 2 and 3 present a performance comparison between analytical and experimental results. There still exist notable differences between theory and experiment.

Conclusions

Several conclusions concerning the analysis are to be made.

1) For perfect blade alignment ($\beta = 0$), the average side force is zero. If the angle β is not zero, a net force perpendicular to the wind will be developed.

2) The reduced frequency ($\Omega c/2V_{\text{local}}$) has the same value for all test data used. The value is about 0.04, small enough that the aerodynamics should be quasisteady unless static stall is approached by the blades. Incorporation of the effects of unsteady lift into the analysis will result in two effects. First, the magnitude of the lift developed will be reduced. This will result in lower predicted performance. Second, the lift will lag the angle of attack. The principle effect of the phase lag is that the rotor will experience a net side force.

3) Available test data covers power and overall force measurements only. A wake velocity survey has not been made by any of the investigators (Muraca[7] made one traverse). Since any aerodynamic theory for the Darrieus rotor requires explicit knowledge of the induced velocity, a fundamental piece of information has yet to be obtained.

4) Wind tunnel tests to date have been made at low blade chord Reynolds numbers. A larger Darrieus rotor (diameter of the order of 100 ft) is expected to have chord Reynolds numbers on the order of 10^6. This increase in Reyonlds number is expected to yield lower sectional drag coefficients and higher sectional lift coefficients. Both of these effects will increase the performance of the Darrieus rotor by a significant amount.

References

[1] South, P. and Rangi, R., "The Performance and Economics of the Vertical-Axis Wind Turbine Developed at the National Research Council, Ottawa, Canada," presented at the 1973 Annual Meeting of the Pacific Northwest Region of the American Society of Agricultural Engineers, Calgary, Alberta, Oct. 10-12, 1973.

[2] Darrieus, G. J. M., U.S. Patent No. 1,835,018, Dec. 8, 1931,

[3] Templin, R. J., "Aerodynamic Performance Theory for the NRC Vertical-Axis Wind Turbine," National Research Council of Canada, LTR-LA-160, June 1974.

[4] Wilson, R. E. and Lissaman, P. B. S., "Applied Aerodynamics of Wind Power Machines," NSF (RANN) Grant No. GI-41840, Oregon State University Rept. May 1974.

[5] Muraca, R. J., Stephen, S., Maria V., and Dagenhart, R. J., "Theoretical Performance of Vertical-Axis Windmills," NASA TMX-726662, May 1975.

[6] South, P. and Rangi, R. S., "An Experimental Investigation of a 12 Ft. Diameter High Speed Vertical Axis Wind Turbine," National Research Council of Canada, LTR-LA-166, April 1976.

[7] Muraca, R. J., "Wind Tunnel Investigation of a 14 Ft. Vertical-Axis Windmill," NASA, May 1975.

[8] Blackwell, B. F. and Reis, G. E., "Blade Shape for a Troposkien Type of Vertical-Axis Wind Turbine," Sandia Laboratories, Albuquerque, N.M. SLA-74-0154, April 1974.

Announcement: 1976 Author and Subject Index

The indexes of the four AIAA archive journals (*AIAA Journal, Journal of Spacecraft and Rockets, Journal of Aircraft,* and *Journal of Hydronautics*) will be combined and mailed separately early in 1977. In addition, papers appearing in volumes of the *Progress in Astronautics and Aeronautics* book series published in 1976 will be included. Librarians will receive one copy of the index for each subscription which they have. Any AIAA member who subscribes to one or more Journals will receive one index. Additional copies may be purchased by anyone, at $10 per copy, from the Circulation Department, AIAA, Room 730, 1290 Avenue of the Americas, New York, New York 10019. **Remittance must accompany the order.**

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