축류터빈의 동익에서 끝간격 누설유동에 의한 편향각과 압력손실의 모형화

Modeling of Deviation Angle and Pressure Loss due to Rotor Tip Leakage Flow in Axial Turbines

윤의수*, 오군섭*, 정명균**
(*한국기계연구원, **한국과학기술원)

A simple model of the tip leakage flow models of the rotor downstream flow is developed, based on Lakshminarayana's theoretical concept on the tip clearance flow and the experimental data published in open literature. And new spanwise distribution models of deviation angle and pressure loss coefficient due to the tip leakage flow are formulated for use in association with the streamline curvature method as a through flow analysis. Combining these new models and previous deviation and loss models due to secondary flow, a robust streamline curvature method is established for flow analysis of single-stage, subsonic axial turbines with wide ranges of turning angle, aspect ratio and blading type. At the exit from rotor rows, the flow variables are mixed radially according to a spanwise transport equation. The proposed streamline curvature method is tested against a forced vortex type turbine as well as a free vortex type one. The results show that the spanwise variations of flow angle, axial velocity and loss coefficients at rotor exit are predicted with good accuracy, being comparable to a steady three-dimensional Navier-Stokes analysis. This simple and fast flow analysis is found to be very useful for the turbine design at the initial design phase.