Photoelastic Investigation of Turbine Rotor Blade Shrouds

U. Chandrasekhar  
Gas Turbine Research Establishment, Bangalore

D. Gururaj  
Gas Turbine Research Establishment, Bangalore

K. Ramachandra  
Gas Turbine Research Establishment, Bangalore

R. Padmanabhan  
Gas Turbine Research Establishment, Bangalore

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Abstract

This paper deals with the photoelastic stress analysis carried out to investigate the premature failure of low pressure turbine rotor blade shrouds of an experimental gas turbine. Stress distribution at the shroud aerofoil interface was studied for the original rectangular shroud geometry by stress freezing the photoelastic model blades under rotating conditions. The combined influence of taper shroud geometry and larger fillet radius in mitigating the shroud stress is studied by the three dimensional photoelastic technique and an optimised shroud geometry subject to the stress requirements of blade material is suggested.

Author Biographies

U. Chandrasekhar, Gas Turbine Research Establishment, Bangalore  
Gas Turbine Research Establishment, Bangalore - 560 093

D. Gururaj, Gas Turbine Research Establishment, Bangalore  
Gas Turbine Research Establishment, Bangalore - 560 093

K. Ramachandra, Gas Turbine Research Establishment, Bangalore  
Gas Turbine Research Establishment, Bangalore - 560 093

R. Padmanabhan, Gas Turbine Research Establishment, Bangalore  
Gas Turbine Research Establishment, Bangalore - 560 093

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The tip leakage flow losses of the shrouded rotor blade contribute significantly to overall losses of the turbine stage. Effects of the shrouded rotor blade tip leakage flow in stator blade/shrouded rotor blade/stator blade on the aerodynamic performance of a 1.5 axial turbine stage were numerically investigated using commercial CFD software CFX-TASCflow. Three conditions with different numbers of sealing fins in the rotor blade shroud were simulated. The structure of the leakage flow and its influence to the next stator were presented.


The effect of rotor blades passing in and out of a partial arc jet occurs in a milder form as blades pass through the wakes of a preceding blade row, as shown in Figures 2 and 3. Due to the momentum loss of flow near a blade surface, jets are formed, as the flow leaves the blade row. From the photoelastic stress analysis point of view, this configuration is still two-dimensional. 8-b. Points of highest tensile stress at the geometrical shape of blade roots and shrouds. Based on differences in steam quality, operation, blade surface preparation, installation, location of blades within the unit, first row, intermediate rows; or last row etc., one type of blade may fail before another. 4. 1 Internal Groove Root.