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Rotordynamic Analysis of a Single Stage Steam Turbine Rotor with One Row of Moving Blades

B. Gurudatt[1] and S. Seetharamu[2]

Summary

Dynamic phenomena are some of the predominant criteria effectuating the failure of rotating turbo machinery. The ambient interaction of these turbo machines is of cardinal importance, since operating them at the certain speed ranges may lead to either long term dynamic fatigue due to induced alternating stresses or resonant failure. Dynamically sound design of machinery in aerospace application is not only crucial from the monetary stand point, but also from safety perspective.

The potential consequence of "ambient interaction" are referenced to highlight the common outcomes of the structural interaction of the turbo machine rotor with host of detrimental ambient factors. Resonant vibrations incited by the running speed harmonic excitation, steam impinging frequency, engine order excitation and blade /disc unbalances are fundamental causes for the failure of turbine components. An attempt is made to evaluate the rotor dynamic properties of the rotor-bearing system of a contemporary steam turbine rotor under the influence of these factors. The results of these analyses provide significant inputs for more reliable design of small capacity steam turbine rotors.

The main stream disciplines that are encompassed by this project are Modal and Rotordynamic analysis. Modal analysis is performed to estimate the critical/resonant speeds and study the mode shapes of the bladed rotor disc and rotordynamic analysis is employed to evaluate dynamic characteristics of the rotor bearing system. Analytical procedures (Finite Element Analysis) were adopted to execute the project, and were implemented in ANSYS*.

The scope of this project is limited to modal and dynamic analysis of the bladed rotor alone. The primary object of this project is to study the undamped critical speed behavior, the damped unbalanced response, and the damped eigenvalue behavior of steam turbine rotor. The secondary objective of this project is to study the critical speeds and mode shape of the bladed rotor disc, under prestressed and stress stiffened conditions.

keywords: Turbine rotor, Turbo machinery, Bladed rotor disc, Modal analysis, Resonant vibration

[1]Professor, Department of Mechanical Engineering, Bangalore Institute of Technology, Bangalore, Email: gurudatt_bgd@yahoo.co.in

[2]Additional Director, Central Power Research Institute, Ministry of Power, Materials technology division, Bangalore, Email: ssramu@powersearch.cpri.res.in