

Stress Analysis of a Fan/Compressor Rotar Blade Under the Influence of Tip-Rub

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ABSTRACT

Rotor blades are the very commonly used in machine components in hi-tech applications and in general are used as a very preliminary mechanical element. These blades are subjected to various loads such as centrifugal loading, gas forces, inertia loading and thermal loadings out of which centrifugal loading is the major component contributing to the stress developed in the blades. Also the vibration plays a very important role in the working of these blades. Hence the design of these blades has to be taken care since these are used in compressors and turbines, which are used in aerospace applications in which high cost and safety are involved. When the blades are rotated at very high speed centrifugal pressure is developed on the blade, which tends to through the blade away from the hub to which it is fixed. The pressure which acts on the blade is given by $P = \rho\omega^2 rt$. Other forces acting on the blades contribute to only 10% of the centrifugal loads. Due to the centrifugal loads the blades tends to extend towards the periphery thus making contact with the casing provided which exerts a compressive and bending load on the blade. In the present work an attempt has been made to study the effect of these rubbing forces on the blades. The typical turbine blade which is tapered and twisted, is taken into consideration and a single blade is analyzed due the symmetry that exists in the arrangement of these blades. This blade was subjected to centrifugal tensile loading compressive loading due to the presence of the casing and the rubbing forces or the frictional forces on the blade which is exerted by the casing. Static analysis was carried out on these blades using commercial Finite Element package to find the stress distribution. The geometry of the blade is shown in the figure below.