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An Fem Analysis & Observation on Linear Static Analysis of Bolt used in Steam Turbine

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ABSTRACT: Casing withstands steam pressure & support internal components. Material used for casing is chromium steels. Bolts and diameter of bolt holes play a vital role between casings failure of which is harmful to external environment.

Casings are subjected to very high pressure & high temperature steam. High pressure steam causes stresses on casing wall which is responsible for cracking & casing distortion (deformation) if it crosses yield stress. High temperature causes thermal stresses on casing walls which is responsible for thermal failure if it crosses the yield limit. Holes & notches are the critical area for crack growth as it is highly stress concentrated area. If it is reduced the stresses can be reduced greatly and also material can be saved considerably. Fatigue failure is the failure of a component subjected to cyclic stress over the period of time. Hence life evaluation of the component is important.

KEYWORDS: Casings Fatigue failure yield stress

I. INTRODUCTION

Steam turbines are widely used for marine applications for vessel propulsion systems. In recent times gas turbines, as developed for aerospace applications, are being used more and more in the field of power generation once dominated by steam turbines

Figure: A General Electric D11 Model of a Steam Turbine

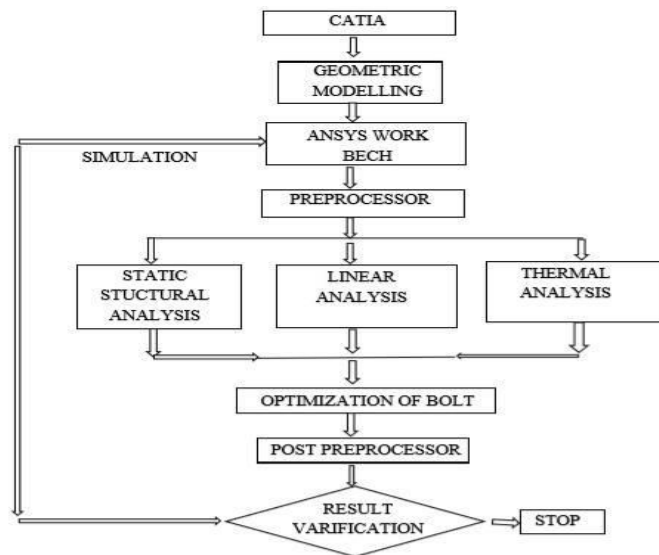


In a power plant, the steam turbine is attached to a generator to produce electrical power. The turbine acts as the more mechanical side of the system by providing the rotary motion for the generator, while the generator acts as the electrical side by employing the laws of electricity and magnetism to produce electrical power.

from the boiler to the turbine is the Main Stop Valve (MSV), which is either fully open or fully closed. The MSV does not control the steam flow other than to completely stop it. The terms "throttle pressure" and "throttle conditions" refer to steam as it is entering the MSV. The steam hits the first row of blades at elevated pressure. Its pressure is so high, in fact, that it can produce a torque with just a small surface area. The steam's impact causes the rotor to begin turning. As the turbine stages progress, however, the steam loses density, thus requiring increasingly large surface areas. For this reason, the size of the blades increases with each stage. When the steam leaves the turbine, it has dropped over 900 °F and has lost almost all of its elevated pressure. Most of the pressure drop occurs across the diaphragm, which is a component between the outer wall and inner web.

II. METHODOLOGY

Problem Identification: casings are subjected to very high pressure & high temperature steam. High pressure steam causes stresses on casing wall which is responsible for cracking & casing distortion (deformation) if it crosses yield stress. High temperature causes thermal stresses on casing walls which is responsible for thermal failure if it crosses the yield limit. Holes & notches are the critical area for crack growth as it is highly stress concentrated area. If it is reduced the stresses can be reduced greatly and also material can be saved considerably. Fatigue failure is the failure of a component subjected to cyclic stress over the period of time. Hence life evaluation of the component is important Chromium steel (G17CrMo55) is used for casing and bolts material with specific mechanical properties. The geometric model is generated using CAD package. Analysis is performed using ANSYS WORKBENCH 14.5 by imposing different boundary conditions. The FEM results are analysed to check whether design is safe or not.



III. EXPERIMENTAL RESULTS

FEM ANALYSIS & OBSERVATIONS

Geometric Model



Meshing



Boundary Condition

The boundary condition need to be specified before solving any engineering problem. It specifies the specific boundary within which problem need to be solved. The boundary conditions may be fixing supports at one ends, both ends etc.

Bolt Optimization

Bolts

Bolted joints are one of the most common elements in construction and machine design. They consist of fasteners that capture and join other parts and are secured with the mating of screw threads.

There are two main types of bolted joint designs: tension joints and shear joints.

In the tension joint, the bolt and clamped components of the joint are designed to transfer an applied tension load through the joint by way of the clamped components through the design of a proper balance of joint and bolt stiffness.

Importance of Bolts

Provides firm contact between parts.

Avoid leakage even at higher operating pressure.

Critical part, failure of which can cause steam leakage and hazardous to environment.

Bolts have critical stress concentration area.

IV. CONCLUSION

linear Static Analysis (BOLT)

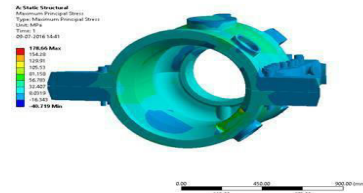
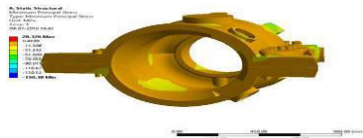
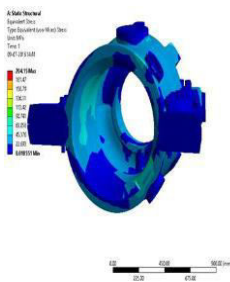


Fig 1 Von Mises Stress Fig 2 : Minimum Principal Stress in Steam Turbine Casing
Fig 3 max principal stress

The objectives of this present work is to study the Linear static analysis, Steady state thermal analysis of casing of a steam turbine, Bolts optimization, Life evaluation of casing of a steam turbine under specified boundary

The linear static analysis showed that the design is safe for static pressure of 5MPa from the evidence of von-mises stress, principal stresses, deformation developed since it is well within the yield stress (535 MPa) specified for chromium steel.

The Statical Analysis for different bolt dia i.e. 40, 32, 30 of casing is performed and all the results were compared. The result proved that the casing with 30mm dia has least stresses and it is recommended. Stress intensity area is reduced considerably

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